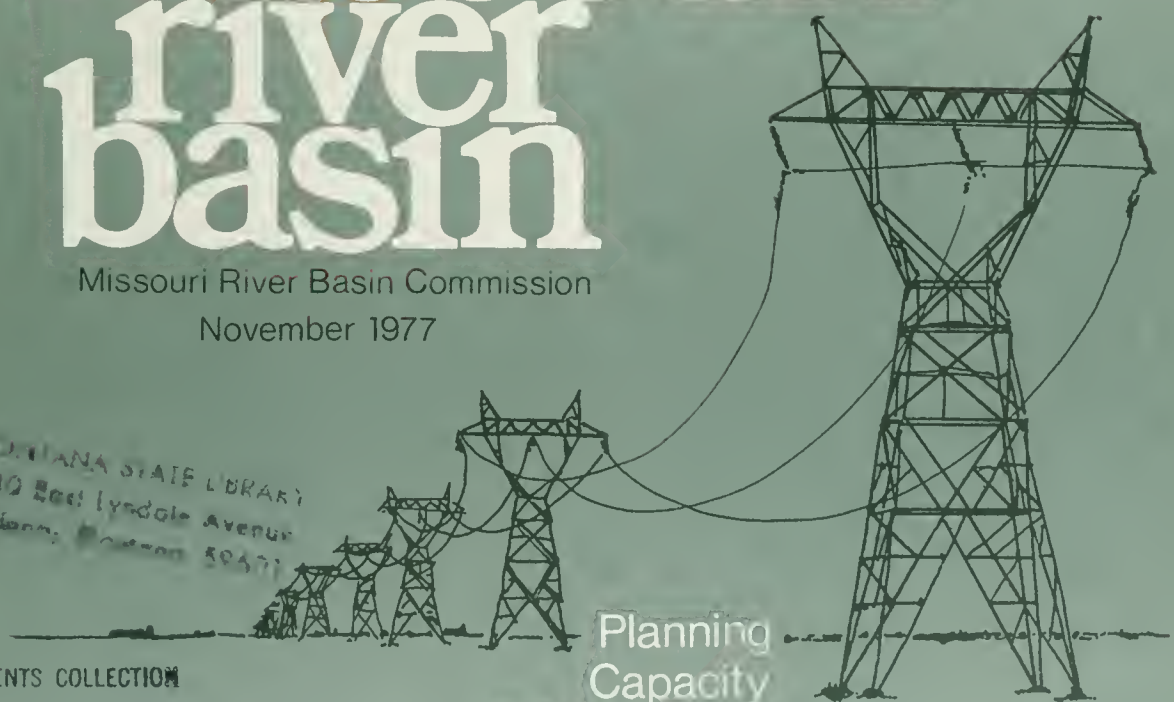
status of electric power in the missouri river basin

Missouri River Basin Commission
November 1977



Planning
Capacity
Future Needs
Research
Environmental Quality
Laws and Policies
Problems and Issues

mrbc

The Missouri River Basin Commission is the principal agency for the coordination of Federal, State, interstate, local and nongovernmental plans for the development of water and related land resources in the area served by the Missouri River and its tributaries. As an independent regional commission, it also provides a forum in which States meet with Federal agencies to conduct water and related land resources planning. The Commission's chairman is appointed by the President; its vice-chairman is elected from among State members.

MRBC members are Colorado; Iowa; Kansas; Minnesota; Missouri; Montana; Nebraska; North Dakota; South Dakota; Wyoming; Department of Agriculture; Department of the Army; Department of Commerce; Energy Research and Development Administration; Environmental Protection Agency; Federal Power Commission; Department of Health, Education and Welfare; Department of Housing and Urban Development; Department of the Interior; Department of Transportation; Yellowstone River Compact Commission; Big Blue River Compact Administration. Canada is an observer.

STATUS OF ELECTRIC POWER IN THE MISSOURI RIVER BASIN

- Planning
- Capacity
- Future Needs
- Research
- Environmental Quality
- Laws and Policies
- Problems and Issues

MISSOURI RIVER BASIN COMMISSION
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November 1977

PREFACE

Many individuals and officials are making decisions each day in the Missouri River Basin involving energy, land, and water resources. Generation of electric power, its distribution, and use probably has more impact on the area than any other form of energy at the present time. Many persons who are closely affiliated with the electrical power industry are well aware of the problems facing the basin and what is being done to solve those problems. However, those on the periphery of the industry engaged in related activities are often not aware of what is being accomplished or what is being planned for the future. A wide spectrum of the interested public must also be included in this second category.

This second annual Missouri River Basin Commission report on Status of Electric Power in the Missouri River Basin provides information on the status of electric power generation, future needs, and potentials for meeting these needs. It highlights some of the research and development being conducted to help solve present and future problems and discusses environmental studies related to power production and energy development. State and Federal members of the Missouri River Basin Commission provided sections of this report based largely on 1976 information together with 1974-75 data for comparative purposes. Some Federal legislative activities have been included and extend into calendar year 1977.

It is planned to update and improve the Status of Electric Power Report annually. Although presently limited to electric power, it is anticipated that the report could be expanded to include other forms of energy as more information becomes available in the future.

ACKNOWLEDGEMENTS

This report was prepared by the Missouri River Basin Commission staff under the overall direction of the Commission's Energy and Water Committee:

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Photo Credits

Omaha Public Power District, p. 12
U.S. Army Corps of Engineers, p. 29
Energy Research and Development Administration, pp. 36, 41
Peabody Coal Company, p. 46
Wyoming Highway Department, p. 54

GLOSSARY

Alternative coal technologies -- Processes whereby coal is converted to either oil or gas.

Gasification -- Refers to the conversion of coal to a gas fuel.

High Btu gasification -- The process of converting coal to an equivalent of natural gas, predominantly methane; obtained by methanating synthesis gas; energy content is usually 950-1,000 Btu's per cubic foot.

Low Btu gasification -- The process of converting coal to gas, obtained by partial combustion of coal; energy content is usually 100 to 200 Btu's per cubic foot.

Liquefaction -- The process by which gas is converted from the gaseous to the liquid phase.

Btu (British thermal unit) -- The amount of energy necessary to raise the temperature of one pound of water by one degree Fahrenheit, from 39.2 to 40.2 degrees Fahrenheit.

Carbon dioxide (CO_2) acceptor process -- A high-Btu coal gasification process where pulverized coal, hot dolomite, and steam are used to produce a low sulfur, low carbon monoxide, and carbon dioxide high quality gas.

Coal -- A solid, combustible organic material.

Bituminous -- An intermediate rank coal with low to high fixed carbon, intermediate to high heat content, a high percentage of volatile matter, and a low percentage of moisture.

Lignite -- The lowest rank coal, with low heat content and fixed carbon, and high percentages of volatile matter and moisture; an early stage in coal formation.

Subbituminous -- A low rank coal with low fixed carbon and high percentages of volatile matter and moisture.

Fluridized bed combustion -- The burning of a body of finely crushed particles with a gas blown through them. The gas separates the particles so that the mixture behaves like a turbulent fluid.

Hydropower -- Production of electricity that uses falling water as the motive force to drive turbine-generators.

Low-head hydro -- Refers generally to those dam sites less than 20 meters in vertical height and producing or capable of producing less than 15,000 kilowatts.

Pumped-storage hydro -- A hydroelectric power plant utilizing an arrangement whereby electric energy is generated for peak load use by utilizing water pumped into a storage reservoir during off-peak periods. Such plants can be used to provide reserve generating capacity.

In situ -- In the natural or original position; applied to energy resources when they are processed in the location where they were originally deposited.

Interties -- A tie or feeder permitting a flow of energy between the transmission facilities of two electric supply systems. The flow of energy may be in either direction.

Load shedding -- The process of reducing or transferring system loads to other systems, usually associated with declines in voltage frequency.

Low sulfur coal -- A solid, combustible organic material; coal with a sulfur content generally below one percent.

Magnetohydrodynamics (MHD) -- An electrical generation process where direct current electricity is produced directly from thermal energy.

Nuclear power -- Energy released from the heat liberated by a nuclear reaction (fission or fusion) or by radioactive decay and converted to electric power by a turbine-generator unit.

Fast breeder reactor -- A nuclear reactor that produces more fissile material than it consumes. This reactor is called the fast breeder reactor because high energy (fast) neutrons produce most of the fissions.

High temperature gas reactor -- A nuclear reactor in which helium gas is the coolant with graphite fuel elements containing coated particles of highly enriched uranium plus thorium.

Light water reactor -- A nuclear reactor which uses water (H_2O) to transfer heat from the fissioning of uranium to a steam turbine.

Peak load -- The greatest amount (maximum) of all of the power load on a system which has occurred at one specified time.

Spinning reserve -- Generating capacity operating at no load or at partial load with excess capacity available to support additional load.

Voltage -- The electrical potential difference between conductors.

Gigawatt (GW) -- One million kilowatts, or one billion watts

GWH -- Gigawatt-hour

Kilovolt (kV) -- One thousand volts

Kilowatt (KW) -- One thousand watts

KWH -- Kilowatt-hour

Megawatt (MW) -- One thousand kilowatts, or one million watts

MWH -- Megawatt-hour

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ERRATA SHEET

Page	Correction
Figure 1 (Preceding page 3)	The USBR abbreviation should read WAPA (Western Area Power Administration) in the Utility Code legend.
Figure 3 (Preceding page 11)	Plant number 22 should be properly listed as E.F. Wisdom in the Generating Plant table.
Figure 3 (Preceding page 11)	The abbreviation USAR should be changed to USCE (U.S. Army Corps of Engineers) in the Utility Code legend.
Figure 3 (Preceding page 11)	Plant numbers 10, 12, 17, 18, 19, 50, and 87 should have USCE listed as their utility code in the Generating Plant table.

CHAPTER 1: ELECTRIC POWER PLANNING AND COORDINATION

The widespread use of electricity is relatively new to the American life style. Nearly a third of the population can remember when many homes were without electricity and the service was unreliable. In the past 25 years, the use of electric power in the United States has increased five times. Moreover, our dependence on electricity has been brought into focus by recent fuel oil and natural gas shortages affecting the generation and the cost of electricity.

In response to cost increases and fuel shortages, power planning and coordination must be recognized as a necessary part of the effort to maximize cost savings, reduce duplication of facilities, and increase the reliability and adequacy of bulk power supply systems. In recognition of the benefits that can accrue from these joint activities, electric utility systems have, in increasing numbers, joined with neighboring systems to pursue these common goals. Within the Missouri River Basin, this effort is carried out by all segments of the industry, from large bulk power supplying systems having thousands of megawatts of generating capability to small municipal systems with little or no generating capability.

POWER PLANNING ARRANGEMENTS

National Reliability Council Power Planning

A majority of large-scale electric power planning in the United States and parts of Canada is conducted by the National Electric Reliability Council (NERC). The Council, including its nine regional reliability councils, was formed voluntarily by the electric utility industry in 1968 to augment the reliability and adequacy of bulk power supply systems. NERC was created by, and represents, all sectors of the utility industry, public and private. Portions of four of NERC's nine regional councils cover the Missouri River Basin as shown on figure 1. (Figure 1 also shows major utility system service areas. The generalized map does not, however, show the service areas of the many smaller electric systems that provide service throughout the basin. A complete list of these power suppliers and their organizational affiliations is contained in appendix 1.) The Mid-Continent Area Reliability Coordination Agreement (MARCA) and the Western Systems Coordinating Council (WSCC) represent the larger areas within the Missouri River Basin. MARCA covers all of North Dakota, Iowa, and Minnesota, most of Nebraska and South Dakota, and a part of Montana within the basin. WSCC represents all of Wyoming and Colorado within the basin, portions of Montana and Nebraska, and the western edge of South Dakota. The Southwest Power Pool (SPP) includes the Kansas portion of the basin and the western half of Missouri. The Mid-America Interpool Network (MAIN) includes a portion of the State of Missouri in the southeast corner of the basin.

- Mid-Continent Area Reliability Coordination Agreement (MARCA)

The Mid-Continent Area Reliability Coordination Agreement covers the major electric utilities engaged in bulk power supply within the States of Iowa, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin. Purposes of the agreement include increased reliability of the area's bulk power supply and coordination of the planning and operation of electric facilities in the region. Members of MARCA are listed below:

Members (asterisk denotes service operation within the Missouri River Basin)

*Basin Electric Power Cooperative
*Cooperative Power Association
Dairyland Power Cooperative
Eastern Iowa Light & Power Cooperative
*Interstate Power Company
*Iowa Electric Light & Power Company
*Central Iowa Power Cooperative
Iowa-Illinois Gas and Electric Company
*Iowa Power and Light Company
*Iowa Public Service Company
*Corn Belt Power Cooperative
*Iowa Southern Utilities Company
Lake Superior District Power Company
Minnesota Power and Light Company
*Minnkota Power Cooperative, Inc.
*Montana Dakota Utilities Company
*Nebraska Public Power District
*Northern States Power Company
*Northwestern Public Service Company
*Omaha Public Power District
*United Power Association
*U.S. Bureau of Reclamation-Upper Missouri Region-Eastern Division

- Western Systems Coordination Council (WSCC)

WSCC is a voluntary council open to all bulk power suppliers in 13 U.S. Western States and the Canadian province of British Columbia. The purpose of the council is to promote reliable operation of interconnected bulk power systems. All planning for future generation and transmission facilities is the responsibility of the individual member systems and the joint planning groups with which they may be associated. However, before making final commitments for construction, such planning is reported to the WSCC, where studies are conducted to determine the effect of planned changes on the reliability of the entire Western regional bulk power network.

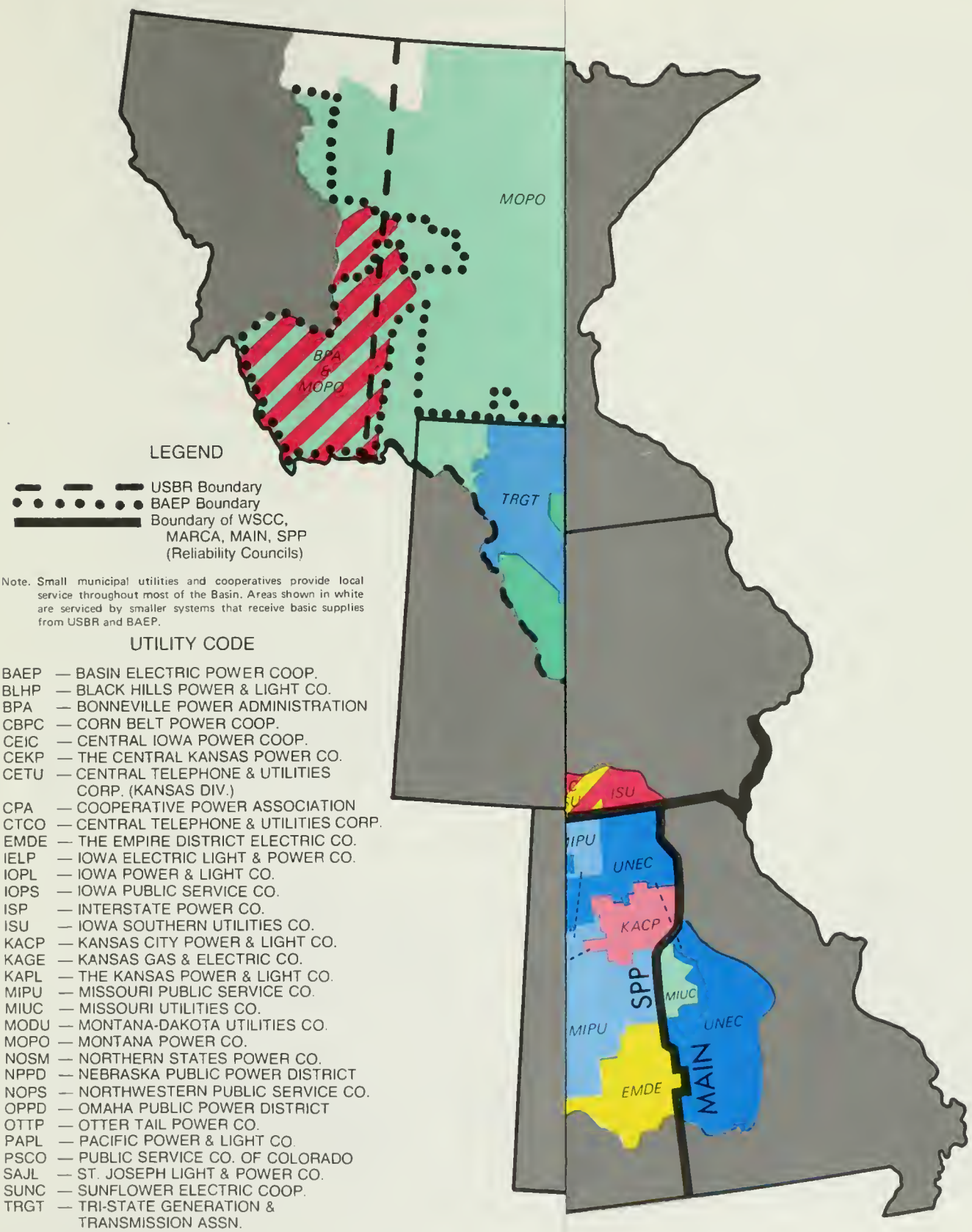
The Planning Coordination Committee accumulates data and performs regional studies of the interconnected systems to determine the electrical stability and associated reliability of the regional bulk power network, and formulates reports and recommendations based on these reports. The Operations Committee reviews and analyzes operating procedures and problems relating to the reliability of the operation of the interconnected bulk power systems, and recommends new or modified operating policies and procedures for the guidance of the member utilities. The Environmental Committee is responsible for recommending criteria, guidelines, and objectives that will help member systems achieve goals of electric power reliability and environmental compatibility. The Committee includes member system representatives and nonutility members including conservationists, educators, and other contributors.

WSCC is comprised of the 46 member systems and 13 affiliate members shown in the following list:

Members (asterisk denotes service operation within the Missouri River Basin)

Arizona Electric Power Coop., Inc.
Arizona Power Authority
Arizona Public Service Company
*Black Hills Power & Light Company
*Bonneville Power Administration
British Columbia Power & Hydro Authority
*Bureau of Reclamation
Plains Electric Generation and Transmission Cooperative
*Platte River Power Authority
Portland General Electric Company
*Public Service Company of Colorado
Public Service Company of New Mexico
PUD No. 1 of Chelan County
PUD No. 1 of Cowlitz County

Figure 1



LEGEND

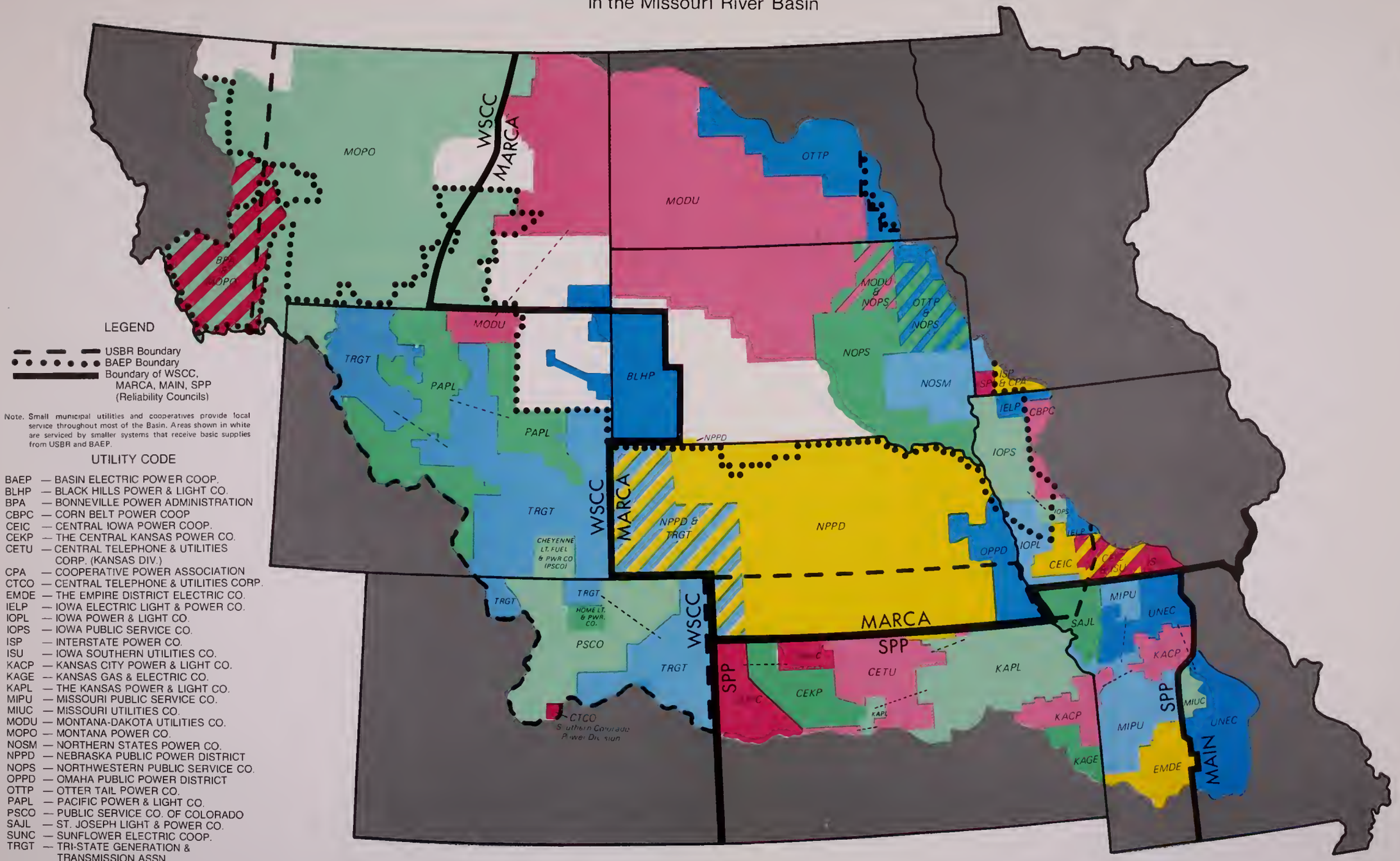
- USBR Boundary
- BAEP Boundary
- Boundary of WSCC, MARCA, MAIN, SPP (Reliability Councils)

Note. Small municipal utilities and cooperatives provide local service throughout most of the Basin. Areas shown in white are serviced by smaller systems that receive basic supplies from USBR and BAEP.

UTILITY CODE

BAEP — BASIN ELECTRIC POWER COOP.
BLHP — BLACK HILLS POWER & LIGHT CO.
BPA — BONNEVILLE POWER ADMINISTRATION
CBPC — CORN BELT POWER COOP.
CEIC — CENTRAL IOWA POWER COOP.
CEKP — THE CENTRAL KANSAS POWER CO.
CETU — CENTRAL TELEPHONE & UTILITIES CORP. (KANSAS DIV.)
CPA — COOPERATIVE POWER ASSOCIATION
CTCO — CENTRAL TELEPHONE & UTILITIES CORP.
EMDE — THE EMPIRE DISTRICT ELECTRIC CO.
IELP — IOWA ELECTRIC LIGHT & POWER CO.
IOPL — IOWA POWER & LIGHT CO.
IOPS — IOWA PUBLIC SERVICE CO.
ISP — INTERSTATE POWER CO.
ISU — IOWA SOUTHERN UTILITIES CO.
KACP — KANSAS CITY POWER & LIGHT CO.
KAGE — KANSAS GAS & ELECTRIC CO.
KAPL — THE KANSAS POWER & LIGHT CO.
MIPU — MISSOURI PUBLIC SERVICE CO.
MIUC — MISSOURI UTILITIES CO.
MODU — MONTANA-DAKOTA UTILITIES CO.
MOPO — MONTANA POWER CO.
NOSM — NORTHERN STATES POWER CO.
NPPD — NEBRASKA PUBLIC POWER DISTRICT
NOPS — NORTHWESTERN PUBLIC SERVICE CO.
OPPD — OMAHA PUBLIC POWER DISTRICT
OTTP — OTTER TAIL POWER CO.
PAPL — PACIFIC POWER & LIGHT CO.
PSCO — PUBLIC SERVICE CO. OF COLORADO
SAJL — ST. JOSEPH LIGHT & POWER CO.
SUNC — SUNFLOWER ELECTRIC COOP.
TRGT — TRI-STATE GENERATION & TRANSMISSION ASSN.
UNEC — UNION ELECTRIC CO.
USBR — UNITED STATES BUREAU OF RECLAMATION

Regional Reliability Council Boundaries and Major Utility System Service Areas in the Missouri River Basin



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UNEC — UNION ELECTRIC CO.
USBR — UNITED STATES BUREAU OF RECLAMATION

City of Colorado Springs
Colorado-Ute Electric Association
Corps of Engineers (North Pacific Div.)
Department of Water Resources, California
El Paso Electric Company
Eugene Water & Electric Board
Glendale Public Service Department
*Idaho Power Company
Los Angeles Dept. of Water and Power
Metropolitan Water District, Southern California
*The Montana Power Company
*Nebraska Public Power District
Nevada Power Company
Pacific Gas and Electric Company
*Pacific Power & Light Company
City of Pasadena
PUD No. 1 of Douglas County
PUD of Grant County
Pudget Sound Power & Light Company
Sacramento Municipal Utility District
Salt River Project
San Diego Gas & Electric Company
City of Seattle, Dept. of Lighting
Sierra Pacific Power Company
Southern California Edison Company
Southern Colorado Power Div., Central Telephone & Utilities Corp.
City of Tacoma, Dept. of Public Utilities - Light Division
*Tri-State G & T Association
Tucson Gas & Electric Company
Utah Power & Light Company
The Washington Water Power Company
West Kootenay Power & Light Company

Affiliate Members

City of Anaheim
Bountiful City Light & Power
PUD of Clark County, Vancouver, Washington
Electrical District No. 2, Coolidge, Arizona
Garkane Power Association, Inc.
Lamar Utilities Board (City of Lamar)
City of Lodi
Navajo Tribal Utility Authority
City of Palo Alto
City of Redding
City of Riverside
City of Santa Clara
City of St. George

- Southwest Power Pool (SPP)

The Southwest Power Pool is a regional coordinating council consisting of 36 members, 15 of which operate partially or wholly within the Missouri River Basin. The SPP, as one of the nine coordinating groups of the National Electric Reliability Council, performs coordinating and planning functions on a regional basis. Members of SPP are listed below:

Members (asterisk denotes service operation within the Missouri River Basin)

*Associated Electric Cooperative, Inc.
Arkansas Electric Coop. Corp.
Arkansas-Missouri Power Company
Arkansas Power & Light Company
*Board of Public Utilities, Kansas City, Kansas
Cajun Electric Power Coop., Inc.
*Central Kansas Power Company
Central Louisiana Electric Company
City of Chanute, Kansas
City of Coffeyville, Kansas
City of Winfield, Kansas
*Kansas Power & Light Company
Louisiana Power & Light Company
Mississippi Power & Light Company
*Missouri Edison Company
*Missouri Power & Light Company
*Missouri Public Service Company
Missouri Utilities Company
New Orleans Public Service Inc.
Oklahoma Gas & Electric Company
Public Service Company of Oklahoma
*St. Joseph Power & Light Company
Southwestern Electric Power Company

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Colorado-Ute Electric Association
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Department of Water Resources, California
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Eugene Water & Electric Board
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Los Angeles Dept. of Water and Power
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Nevada Power Company
Pacific Gas and Electric Company
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Tucson Gas & Electric Company
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The Washington Water Power Company
West Kootenay Power & Light Company

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City of Anaheim
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City of Santa Clara
City of St. George

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*Central Kansas Power Company
Central Louisiana Electric Company
City of Chanute, Kansas
City of Coffeyville, Kansas
City of Winfield, Kansas
*Kansas Power & Light Company
Louisiana Power & Light Company
Mississippi Power & Light Company
*Missouri Edison Company
*Missouri Power & Light Company
*Missouri Public Service Company
Missouri Utilities Company
New Orleans Public Service Inc.
Oklahoma Gas & Electric Company
Public Service Company of Oklahoma
*St. Joseph Power & Light Company
Southwestern Electric Power Company

*City Power & Light-Independence, Missouri
*City Utilities, Springfield, Missouri
*Empire District Electric Company
Grand River Dam Authority
Gulf States Utilities Company
*Kansas City Power & Light Company
*Kansas Gas & Electric Company
Southwestern Power Administration
Southwestern Public Service Company
*Sunflower Electric Coop.
Western Farmers Electric Coop.
*Western Power Division - CT&U
West Texas Utilities Company

- Mid-America Interpool Network Agreement (Individual System Load Dispatch)

The Mid-America Interpool Network (MAIN), with regional monitoring capability located at Lombard, Illinois, is an organization of power systems serving major load centers in the Midwest. MAIN's primary purpose is to assure the reliability of electric power production and transmission throughout the region it serves. MAIN members coordinate such functions as planning, construction, and utilitization of generating and transmission facilities on a basis that takes into account the needs of the entire region. This enables all MAIN affiliates to engineer, build, maintain, and operate their respective power systems in a consistent, dependable, and efficient manner. MAIN membership consists of the following systems:

Members (asterisk denotes service operation within the Missouri River Basin, double asterisk denotes associate member)

Commonwealth Edison Company

Illinois Group

Central Illinois Light Company
Central Illinois Public Service Company
Illinois Power Company
City of Springfield, Illinois Water, Light and Power
Southern Illinois Power Cooperative
**Association of Illinois Electric Cooperatives
**Western Illinois Power Cooperative

Missouri Group

*Associated Electric Cooperative, Inc.
*Union Electric Company

Wisconsin-Upper Michigan Group (WUM)

Madison Gas and Electric
Wisconsin Electric Power Company
Wisconsin-Michigan Power Company
Wisconsin Power and Light Company
Wisconsin Public Service Corporation
Upper Peninsula Power Company
**Municipal Electric Utilities of Wisconsin

Federal-NERC Power Planning

In addition to regional member coordination, the NERC also cooperates with the Department of Energy in planning for the Nation's future electric energy needs. This monitoring activity is conducted in part under the authority of an FPC order (No. 3834, "Reliability and Adequacy of Electric Service") dated December 13, 1976.

One section of the order established a system for the voluntary reporting on an annual basis of current and projected system data for all components of the electric utility industry. To this end, projections of energy requirements are made each year for the following 10 years. These data are summarized and reported by each of the nine regional electric reliability councils. Information submitted on April 1 each year is to consist of the following:

1. Estimates of monthly peak loads for the first two years of the projection; estimates of summer and winter peak loads for the following eight years; and monthly gross and net energy requirements for the first two years and annual gross and net energy requirements for the following eight years.

2. Itemization of all existing capacity resources in the region and new capacity resources (or retirements) as committed or projected for each year 10 years into the future; including, where known, inservice dates, locations, ownership, types of future generating units, primary fuel and capability for use of alternate fuels including length of time alternate fuel can be used, handling and storage capacity, and capacity exchanges with others at the time of summer and winter peak demands.

3. For each year of the 10-year projection, a tabulation is required showing the indicated capacity margins for reserves at the time of summer and winter peak loads, based on items (1) and (2) above, with an assessment of adequacy of reserves for the first five years of the projection. This assessment includes a statement of the criteria now being used in determining reserve requirements by the council or its appropriate subdivisions and an estimate of the magnitude of the capacity which will be unavailable for service due to scheduled maintenance or other known reasons at the time of the summer and winter peaks for the next five years.

4. A plan of the bulk power transmission network of the region in service at the time of the report (including interties with adjoining regions) and the general routing of facilities committed or tentatively projected for service within six years including identification of principal substations, operating voltages, and projected in-service dates. In addition, the transmission facilities projected for the balance of the 10-year period based on the best information available is requested.

5. A plotting and a description of the base case of the bulk power network of the region (or principal subdivisions) as it exists substantially at the time of reporting and as projected four to six years in the future; and a tabulation based upon calculated operating limits specifying the transmission capability between the region and adjacent regions and between subdivisions of the region; and a tabulation and brief statement on the results of a representative number of contingency cases studied; and similarly, information on stability analyses of the network, including the criteria adopted by the regional council relating to network stability.

6. A description of the principal communication and control systems operating or planned within the region and listing of functions performed by such facilities.

7. For each transmission segment designed to operate at 230 kV (nominal) or higher for which construction has begun or is scheduled to begin within two years from the date of the report, information is requested on the status of consultations with affected local communities and groups and status of applications to State or regional authorities, as appropriate.

8. Information is also requested on the following coordinated regional practices:

a. Load shedding programs, including estimated steps of load reduction at various steps in declining frequency.

b. Emergency power and shutdown facilities to prevent damage to equipment if a station loses system power.

c. Power facilities available for unit startup in the event of total loss of system power.

d. Availability of continuous power independent of system sources for communication and control facilities.

e. Provisions for sustaining the operation of generating units on local loads.

f. Programs for scheduling maintenance outages of generation and transmission facilities.

g. Programs for the selection, setting, and maintenance of relays that affect the overall reliability of the interconnected network.

h. Operating reserve policy.

9. A statement is requested as to the percentages of the projected hydro, nuclear, and fossil-fueled capacity to be installed in the 11th through the 20th years.

10. For the 10th year of the projection, a map is requested showing the general configuration of the transmission network both within the region and the ties to adjacent regions.

Regional Power Planning

In addition to the planning/coordination groups and activities described above, the basin's individual utility systems participate in joint planning through 1 or more of 16 interstate and intrastate organizations or associations. The 16 organizations consist of the following groups:

Mid-Continent Area Power Pool (MAPP)
Associated Mountain Power Systems (AMPS)
Missouri Basin Systems Group (MBSG)

Missouri-Kansas Pool
Platte River Power Authority
Colorado Power Pool
Inland Power Pool
Iowa Pool
Pacific Northwest Coordination Agreement (PNCA)
Rocky Mountain Power Pool (RMPP)
Northwest Power Pool (NWPP)
Intercompany Pool (INTERPOOL)
Pacific Northwest Utilities Conference Committee (PNUCC)
Nebraska Municipal Power Pool
North Dakota Association of Municipals
Western Iowa Municipal Electric Cooperative Association

The principal reason for the establishment of each organization is the combined pooling and sharing of power produced by the individual group members. A detailed listing of the member composition and specific functions and activities of each of the 16 pooling associations is contained in appendix I of this report.

BASIN TRANSMISSION NETWORK AND SYSTEM EXCHANGE CAPABILITY

In the same way that coordinated planning for electric energy development increases reliability and reduces cost, the interconnection of adjacent electric utility systems also represents an attempt to achieve more reliable and economic service. In addition to providing transmission within individual utility service areas, distribution systems are linked together by a network of interties that permit the exchange of power between the transmission facilities of different electric energy supply systems.

All of the bulk power supplying systems within the basin are interconnected via an extensive 115kV, 230kV, or 345kV transmission network. Transmission along the western edge of the Missouri basin is sparsely located and generally operates below the 230kV level. Concentrations of both generation and population centers along the eastern edge of the basin have resulted in greater transmission concentrations and higher voltage levels in this area. Figure 3 (contained in chapter 2) shows the principal electric transmission lines currently serving the area.

The capability to transfer power between contiguous systems provides several major advantages that would not be available should system exchanges not occur. First, the merger of delivery systems encourages the realization of scale economies common to large power generation facilities. Second, power can be transferred within regions and between regions to meet power shortages caused by emergencies. Third, transfers between systems permit the temporary purchase or exchange of electric energy at times of increased demand or excessive supply.

Power transfer capabilities exist for the Missouri River Basin's four regional reliability councils and their numerous member organizations. Each council's exchange capability is reported in table 1 and is graphically presented in figure 2. The reported exchange capabilities represent transfer capabilities above normally scheduled exchanges. Further, import and export totals are not additive.

TABLE 1

ESTIMATED INCREMENTAL NONSIMULTANEOUS POWER TRANSFER CAPABILITIES BETWEEN REGIONAL RELIABILITY COUNCILS IN THE MISSOURI REGION, SUMMER 1977
(MW)

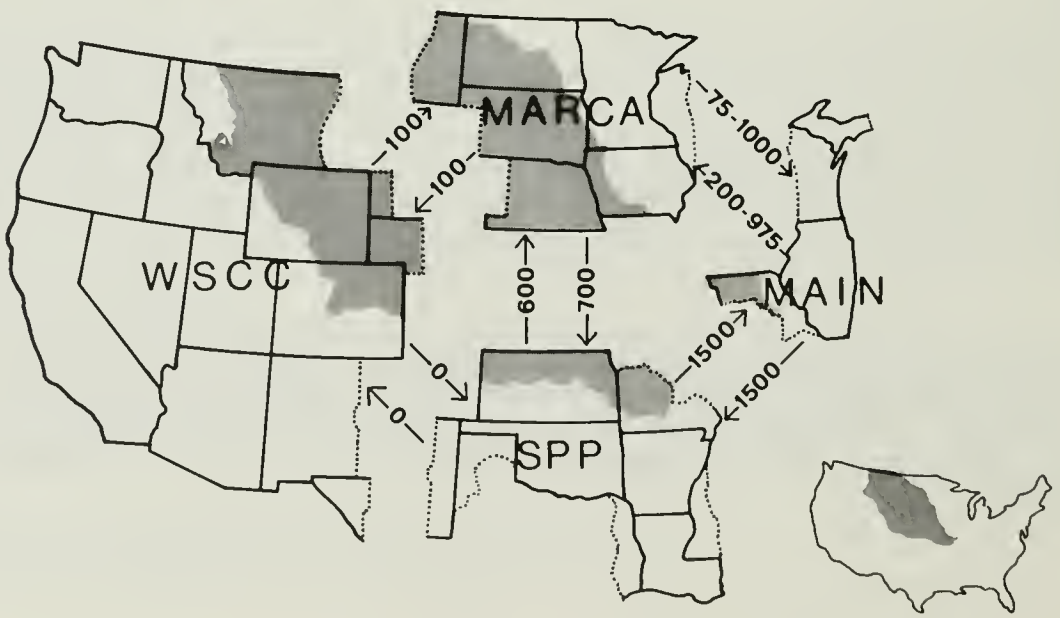
		Import Capability			
		MARCA	WSCC	SPP	MAIN
Export Capability	MARCA	-	100	700	75-1000
	WSCC	100	-	0	0
	SPP	600	0	-	1500
	MAIN	200-975	0	1500	-

Source: FPC, Electric Power Supply and Demand 1977-1986.

Note: For exports, the table should be read from left to right. For example, MARCA can export 100 MW to WSCC, 700 MW to SPP, and 75-1000 MW to MAIN. For the import columns, the table should be read from the top down. For example, MARCA can import 100 MW from WSCC, 600 MW from SPP, and 200-925 from MAIN.

In recent years, system exchange networks have experienced a considerable increase in use. Among the reasons that have accounted for an increase in energy exchanges are transfers based on costs of production, fuel shortages in certain deficit areas, and excess fuel and generation facilities in areas with adequate generation reserves. It can be anticipated that greater energy transfers will occur in the future for reasons similar to those identified above.

Figure 2: Power Transfer Capabilities (MW) for the Regional Reliability Councils, Summer 1977



CHAPTER 2: THE EXISTING ELECTRIC POWER SITUATION

SUPPLY AND DEMAND - 1975

Only small changes in the overall nature of the basin's electric power supply and demand situation were experienced from 1974 through 1975. On the demand side, electric power requirements remained nearly identical to the basin's 1974 needs of approximately 17,500 MW. Conversely, new generating capacity added in 1975 was 8.5 percent of the 1974 total capacity.

At the end of 1975, 399 electric generating plants within the hydrologic boundary of the Missouri River Basin were considered operational. Collectively, the basin power plant total was composed of seven different types of generating facilities. While the total number of inservice plants remained the same in 1975 as in 1974, several changes in plant composition occurred during the year. In particular, the changes included a net loss or removal from service of three fossil-fueled steam plants and one conventional hydropower facility. Despite the net loss of four plants, installed basinwide capacity for both plant types increased by 7.3 percent over 1974 levels.

Net plant additions during 1975 included one internal combustion facility and three combustion turbine units. The addition of the four plants produced a 24 percent increase in installed capacity for these two facility types.

Overall, installed basinwide capacity increased from 21,761 MW in 1974 to 23,611 MW in 1975, and net generation increased from a 1974 total of 85,926 million kilowatt-hours to 92,201 million kilowatt-hours in 1975. Table 2 provides a detailed comparison of 1974 and 1975 composition and production for all plants in the basin.

TABLE 2

EXISTING ELECTRIC POWER SUPPLY IN THE MISSOURI RIVER BASIN
1974 AND 1975

Plant Type	Number of Plants		Installed Capacity (MW)		Net Generation (GWH)	
	1974	1975	1974	1975	1974	1975
Fossil-Fired Steam	91	88	14,447	15,723	62,482	63,760
Nuclear Steam	2	2	1,282	1,282	4,290	5,916
Internal Combustion (Diesel)	216	217	922	940	1,046	1,014
Combustion Turbine	29	32	1,410	1,946	888	1,282
Combined Cycle	1	1	52	52	29	29
Conventional Hydropower	59	58	3,348	3,368	17,372	20,407
Pumped Storage Hydropower	1	1	300	300	181 1/	207 1/
MRB TOTAL	399	399	21,761	23,611	85,926	92,201

1/ Net energy loss due to pumping to upper reservoir.

The bulk of electric power generated in the basin is produced at facilities with 25 MW or greater installed generating capacity. Table 3 provides a comparison of 1974 and 1975 installed capacity by plant type and size of facility.

TABLE 3

INSTALLED GENERATING CAPACITY, BY PLANT TYPE AND SIZE
1974 AND 1975

	1974		1975	
	All Size Plants	+25 MW	All Size Plants	+25 MW
Fossil-Fired Steam	14,477	14,049	15,723	15,358
Nuclear Steam	1,282	1,282	1,282	1,282
Diesel	922	0	940	0
Combustion Turbine	1,410	1,205	1,946	1,773
Combined Cycle	52	52	52	52
Conventional Hydropower	3,348	3,150	3,368	3,150
Pumped-Storage Hydropower	300	300	300	300
TOTAL	21,761	20,037	23,611	21,915

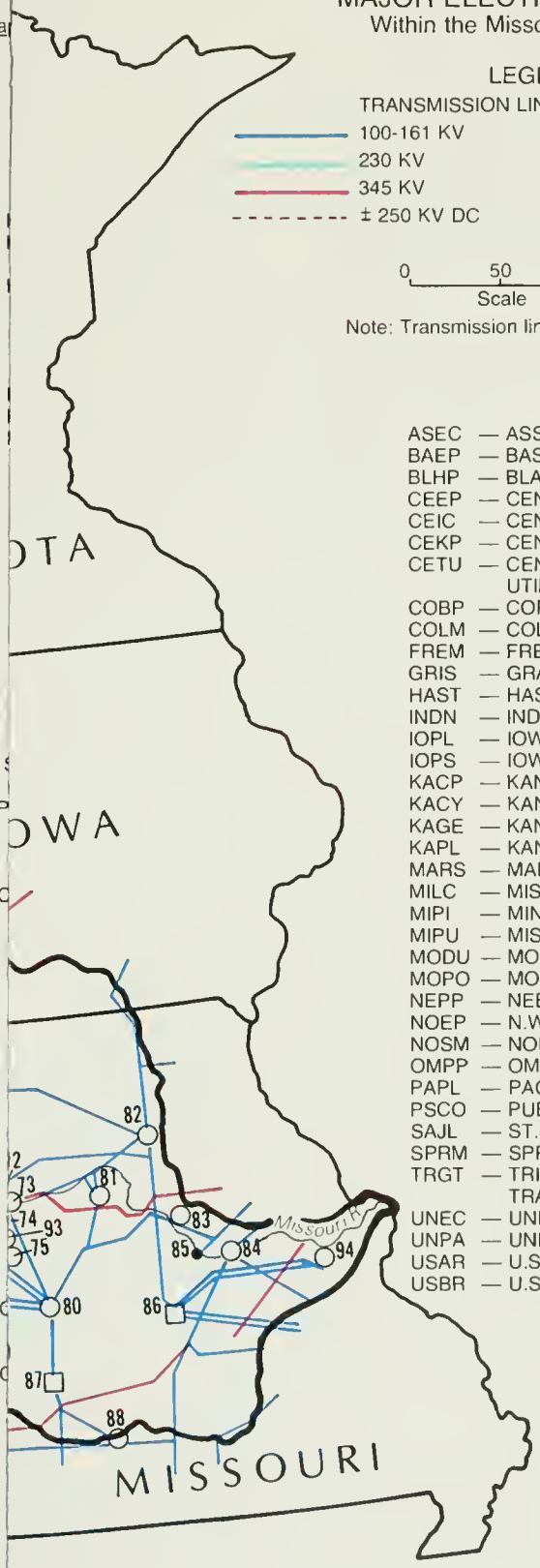
Fossil-fired steam, nuclear steam, and conventional hydroelectric power facilities, while jointly constituting only 38 percent of the total number of plants in the basin, were responsible for generating 98 percent of the basin's electric energy supply in 1975. The 88 fossil-fired steam electric plants in the basin, which accounted for 22 percent of all electric power plants, produced 69 percent of net generated power. Conventional hydropower facilities, which comprised 15 percent of the 1975 plant total, produced about 22 percent of the basin's total 1975 net generation. The basin's two nuclear generating facilities produced approximately 7 percent of the total power generated even though they represented less than 1 percent of the total number of plants located in the Missouri River drainage. Figure 3 shows the location of all generating facilities with 25 MW or greater installed nameplate generating capacity in the basin in 1975, as well as the generalized location of transmission lines with greater than 100kV capacity.

THE FEDERAL POWER SYSTEM

Federally owned power generating plants and transmission facilities are an important component of the Missouri River Basin's entire electric energy production and delivery network. In 1975, the Federal power system accounted for 11.8 percent, or 2,786 MW, of the basin's total installed generating capacity. In addition to existing Federal facilities, 587 MW of new installed capacity is currently under construction or is potentially available for near-term implementation. The completion of ongoing and proposed construction, exclusive of main stem hydropower additions at Fort Peck and Garrison and pumped storage at Fort Randall, would increase the Federal installed capacity contribution to approximately 3,373 MW. With this increase, the Federal share of the basin's projected installed capacity in 1985 would represent 7.5 percent, or a reduction of 4.3 percent over the 1975 Federal share. Proposed conventional hydroelectric

GENERATING PLANTS
25 MW OR GREATER
AS OF DECEMBER 31, 1975

Plant No.	Utility	Plant Name
1	MOPO	Rainbow
2	MOPO	Cochrane
3	MOPO	Ryan
4	MOPO	Morony
5	MOPO	Holter
6	USBR	Canyon Ferry
7	MOPO	J. E. Corette
8	MOPO	Frank Bird
9	USBR	Yellowtail
10	USBR	Ft. Peck
11	MODU	Lewis & Clark
12	USBR	Garrison
13	UNPA	Stanton
14	BAEP	Leland Olds
15	MIPI	M. L. Young
16	MODU	R. M. Heskett
17	USBR	Oahe
18	USBR	Big Bend
19	USBR	Ft. Randall
20	NOSM	Lawrence
21	NOSM	Pathfinder
22	COBP	E. F. Wiscon
23	BLHP	Kirk
24	BLHP	Osage
25	BLHP	Neil Simpson
26	PAPL	Johnston
27	USBR	Alcova
28	USBR	Fremont
29	USBR	Kortes
30	USBR	Seminoe
31	USBR	Estes
32	USBR	Pole Hill
33	USBR	Flatiron
34	PSCO	Valmont
35	PSCO	Cabin Creek
36	PSCO	Arapahoe
37	PSCO	Zuni
38	PSCO	Cherokee
39	PSCO	Ft. Lupton
40	NEPP	Bluffs
41	NEPP	North Platte
42	NEPP	McCook
43	NEPP	Canaday
44	HAST	North Denver
45	GRIS	C. W. Burdick
46	NEPP	Hebron
47	NEPP	Hallam
48	NEPP	Sheldon
49	NEPP	Lincoln
50	USBR	Gavins Point
51	MOPO	Colstrip
52	IOPS	George Neal
53	OMPP	Ft. Calhoun
54	FREM	Fremont
55	OMPP	North Omaha
56	OMPP	Jones Street
57	IOPL	Council Bluffs
58	NEPP	Kramer
59	OMPP	Sarpy
60	CEIC	Summit Lake
61	NEPP	Cooper
62	SAJL	Edmond Street
63	SAJL	Lake Road
64	CETU	Clifton
65	CEKP	Ross Beach
66	KAPL	Abiline
67	KAPL	Tecumseh



MAJOR ELECTRIC FACILITIES
Within the Missouri River Basin

LEGEND

TRANSMISSION LINES
- 100-161 KV
- 230 KV
- 345 KV
- ± 250 KV DC

GENERATING PLANTS
- Combustion Turbine
- Steam
- Nuclear
- Hydro
- Pumped Storage

0 50 100 Miles
Scale

Note: Transmission lines are generalized

UTILITY CODE

ASEC — ASSOCIATED ELECTRIC COOP.
BAEP — BASIN ELECTRIC POWER COOP.
BLHP — BLACK HILLS POWER AND LIGHT CO.
CEEP — CENTRAL ELECTRIC POWER COOP.
CEIC — CENTRAL IOWA POWER COOP.
CEKP — CENTRAL KANSAS POWER CO.
CETU — CENTRAL TELEPHONE AND UTILITIES CORP.
COBP — CORN BELT POWER COOP.
COLM — COLUMBIA
FREM — FREMONT
GRIS — GRAND ISLAND
HAST — HASTINGS
INDN — INDEPENDENCE
IOPL — IOWA POWER AND LIGHT CO.
IOPS — IOWA PUBLIC SERVICE CO.
KACP — KANSAS CITY POWER AND LIGHT CO.
KACY — KANSAS CITY
KAGE — KANSAS GAS AND ELECTRIC CO.
KAPL — KANSAS POWER AND LIGHT CO.
MARS — MARSHALL
MILC — MISSOURI POWER AND LIGHT CO.
MIPI — MINNKOTA POWER COOP., INC.
MIPU — MISSOURI PUBLIC SERVICE CO.
MODU — MONTANA-DAKOTA UTILITIES CO.
MOPO — MONTANA POWER CO.
NEPP — NEBRASKA PUBLIC POWER DISTRICT
NOEP — N.W. ELECTRIC POWER COOP., INC.
NOSM — NORTHERN STATES POWER CO.
OMPP — OMAHA PUBLIC POWER DISTRICT
PAPL — PACIFIC POWER AND LIGHT CO.
PSCO — PUBLIC SERVICE CO. OF COLORADO
SAJL — ST. JOSEPH LIGHT AND POWER CO.
SPRM — SPRINGFIELD
TRGT — TRI-STATE GENERATION & TRANSMISSIONS ASSN.
UNEC — UNION ELECTRIC CO.
UNPA — UNITED POWER ASSOCIATION
USAR — U.S. ARMY
USBR — U.S. BUREAU OF RECLAMATION

Figure 3

GENERATING PLANTS 25 MW OR GREATER AS OF DECEMBER 31, 1975

Plant No.	Utility	Plant Name	Capacity
1	MOPO	Rainbow	H 35
2	MOPO	Cochrane	H 48
3	MOPO	Ryan	H 48
4	MOPO	Morony	H 45
5	MOPO	Holter	H 38
6	USBR	Canyon Ferry	H 50
7	MOPO	J. E. Corette	172
8	MOPO	Frank Bird	69
9	USBR	Yellowtail	H 250
10	USBR	Ft. Peck	H 165
11	MODU	Lewis & Clark	50
12	USBR	Garrison	H 400
13	UNPA	Stanton	172
14	BAEP	Leland Olds	680
15	MIPI	M. L. Young	256
16	MODU	R. M. Heskett	100
17	USBR	Oahe	H 595
18	USBR	Big Bend	H 468
19	USBR	Ft. Randall	H 320
20	NOSM	Lawrence	48
21	NOSM	Pathfinder	75
22	COBP	E. F. Wiscon	37
23	BLHP	Kirk	31
24	BLHP	Osage	34
25	BLHP	Neil Simpson	27
26	PAPL	Johnston	787
27	USBR	Alcova	H 36
28	USBR	Fremont	H 48
29	USBR	Kortes	H 36
30	USBR	Seminoe	H 32
31	USBR	Estes	H 45
32	USBR	Pole Hill	H 33
33	USBR	Flatiron	H 72
34	PSCO	Valmont	St 282
			CT 66
35	PSCO	Cabin Creek	PS 300
36	PSCO	Arapahoe	251
37	PSCO	Zuni	115
38	PSCO	Cherokee	801
39	PSCO	Ft. Lupton	CT 101
40	NEPP	Bluffs	41
41	NEPP	North Platte	H 26
42	NEPP	McCook	CT 36
43	NEPP	Canaday	108
44	HAST	North Denver	50
45	GRIS	C. W. Burdick	93
46	NEPP	Hebron	CT 38
47	NEPP	Hallam	CT 38
48	NEPP	Sheldon	228
49	NEPP	Lincoln	CT 31
			St 31
50	USBR	Gavins Point	H 100
51	MOPO	Colstrip	358
52	IOPS	George Neal	1046
53	OMPP	Ft. Calhoun	N 481
54	FREM	Fremont	43
55	OMPP	North Omaha	644
56	OMPP	Jones Street	St 83
			CT 130
57	IOPL	Council Bluffs	130
58	NEPP	Kramer	112
59	OMPP	Sarpy	CT 110
60	CEIC	Summit Lake	CC 52
61	NEPP	Cooper	N 800
62	SAJL	Edmond Street	43
63	SAJL	Lake Road	St 151
			CT 85
64	CETU	Clifton	CT 85
65	CEKP	Ross Beach	37
66	KAPL	Abilene	St 34
			CT 78
67	KAPL	Tecumseh	St 346
			CT 64
68	KAPL	Lawrence	613
69	KACY	Quindaro	St 334
			CT 82
70	KACP	Hawthorn	908
71	NOEP	Missouri City	40
72	INDN	Jackson Station	CT 119
73	MIPU	Sibley	519
74	INDN	Blue Valley	115
75	MIPU	Ralph Green	50
76	KACP	Northeast	St 133
			CT 253
77	KACP	Grand Avenue	127
78	KACY	Kaw Station	161
79	KAGE	LaCygne	828
80	KACP	Montrose	563
81	MARS	Marshall	27
82	ASEC	Thomas Hill	470
83	COLM	Columbia	107
84	CEEP	Chamois	59
85	MILC	Jefferson City	CT 62
86	UNEC	Osage	H 176
87	USAR	Stockton	H 45
88	SPRM	James River	257
89	NEPP	Columbus	H 39
90	MIPU	Nevada	CT 29
91	TRGT	Wray	CT 201
92	NEPP	Rokeby	CT 49
93	MIPU	Greenwood	CT 116
94	UNEC	Labadie	2482

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- 230 KV
- 345 KV
- ± 250 KV DC

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Scale

Note Transmission lines are generalized

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and pumped-storage additions on the Missouri River main stem would provide an additional 457 MW and 1,180 MW of installed capacity, respectively, and would increase the 1985 Federal share of the basin's total projected installed capacity of 44,732 MW to 11.2 percent.

Projected decreases in the Federal contribution generally reflect previous development of the basin's largest and most naturally favorable hydroelectric sites. Further, projections for the Federal system do not include low-head hydro developments that could have important localized significance. Figure 4, covering the U.S. Bureau of Reclamation's service area, shows most of the existing and proposed Federal power generation and delivery system within the basin. The map does not, however, include the Corps of Engineers' Stockton and Harry S. Truman hydropower facilities in the Missouri portion of the basin. The 45 MW Stockton unit is presently in operation, and the 160 MW Harry S. Truman facility is currently under construction and scheduled for inservice operation in 1980.

FOSSIL FUEL USAGE

Conventional steam-electric plants with installed capacities of 25 MW or greater are responsible for producing almost 90 percent of the total electric energy produced by all fossil fuel generating facilities in the basin. Accordingly, they represent the basin's largest consumer of fossil fuels used to produce electricity. Based on preliminary data, conventional steam-electric plants, 25 MW or greater in size, burned 98 percent of all the coal, 64 percent of all the fuel oil, and 82 percent of all the natural gas used for electric energy production by all the basin's fossil-fired plants in 1976.

Several notable changes in the pattern of fossil fuel usage by conventional steam electric plants (25 MW or greater) took place between 1974 and 1976. The changes include a 53 percent increase in the amount of coal used, a 70 percent increase in the quantity of oil used, and a 54 percent decrease in the volume of gas used. Table 4 provides a basinwide comparison of fossil fuel usage by 25 MW or greater conventional steam-electric plants for the two years.

TABLE 4

FOSSIL FUEL USAGE AT CONVENTIONAL
STEAM PLANTS 25 MW OR GREATER, 1974 and 1976

Year	Fuel Quantity Consumed by Type		
	Coal (Tons)	Oil (Barrels)	Gas (Mcf)
1974	22,388,000	2,119,250	193,512,000
1976	34,181,053	3,592,367	88,867,644

The noticable fuel shift from gas in 1974 to coal in 1976 is due largely to the interruptible (nonavailability) nature of gas supplies during the period. As yet, mandatory fuel conversion or prohibition orders, issued by the Federal Energy Administration (FEA) under the authority of the Energy Supply and Environmental Coordination Act of 1974 (Public Law 93-319), have had little direct impact on fuel conversion by basin energy producers. Five basin plants had been

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tional steam plant in Fremont, Nebraska; (2) the E.F. Wisdom 37 MW conventional steam plant operated by Cornbelt Power Cooperative in Spencer, Iowa; (3) the 115 MW Blue Valley conventional steam plant in Independence, Missouri; (4) the 151 MW conventional steam unit of the Lake Road plant operated by St. Joseph Light and Power Company in St. Joseph, Missouri; and (5) the Lawrence, Kansas, power-plant. FEA has yet to issue Notices of Effectiveness (NOE) of the prohibition orders to the five plants.

As reflected by the fuel usage data reported in table 4, most utilities have already begun voluntary conversion because of unavailable fuel or pending legislation. Most industrial installations in the basin appear to be pursuing a similar course of voluntarily changing primary types of fossil fuel energy sources.

THE USE OF WATER FOR STEAM ELECTRIC COOLING

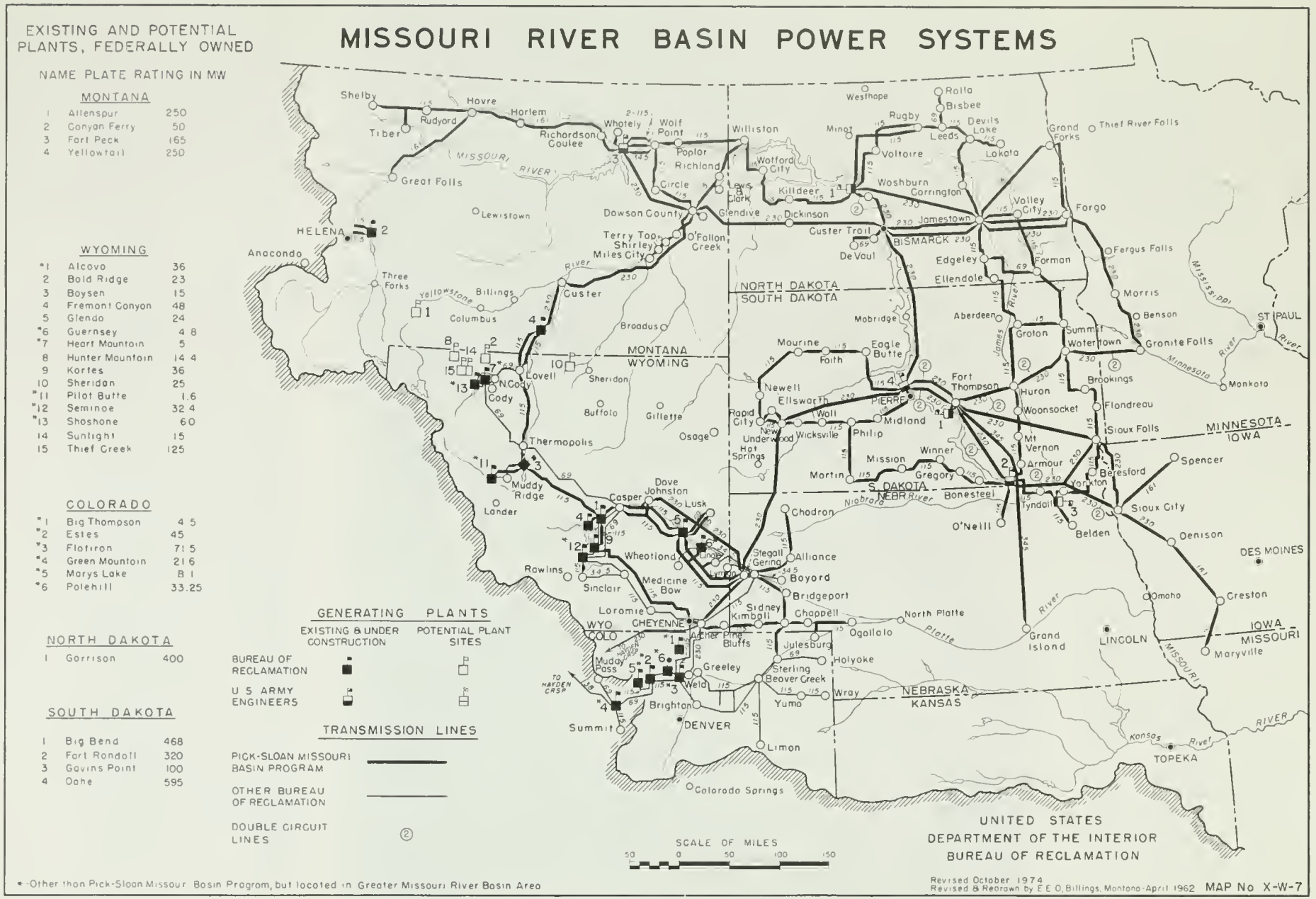
Fossil-fired and nuclear steam electric generating plants require large quantities of water for condenser cooling. The quantity of water required at each plant depends on the type of cooling system utilized, the primary operating efficiency of the plant, the permissible temperature rise for cooling water discharged to the affected water body, and the amount of energy generated.

Four types of cooling systems are available and utilized by generating plants according to factors such as the quantity of heat to be dissipated, the availability of water, and local thermal pollution regulations. The four systems are (1) once-through cooling, (2) cooling ponds, (3) wet cooling towers, and (4) dry cooling towers.

Once-through cooling systems rely on open-cycle circulation where water is withdrawn from an available source (a lake, river, or ocean), circulated through the condenser unit, and returned to the source of origin. This type of system consumes no water directly but does cause increased evaporation through the heating of the receiving water source following discharge.

FORT CALHOUN STATION INTAKE STRUCTURE ON MISSOURI RIVER

Figure 4


MISSOURI RIVER BASIN POWER SYSTEMS
EXISTING AND POTENTIAL PLANTS, FEDERALLY OWNED
NAME PLATE RATING IN MW
MONTANA
1 Allenspur 250
2 Conyon Ferry 50
3 Fort Peck 165
4 Yellowtail 250
WYOMING
*1 Alcovo 36
2 Bold Ridge 23
3 Boysen 15
4 Fremont Conyon 48
5 Glendo 24
*6 Guernsey 4 8
*7 Heart Mountain 5
8 Hunter Mountain 14 4
9 Kortes 36
10 Sheridan 25
*11 Pilot Butte 1.6
*12 Seminoe 32 4
*13 Shoshone 60
14 Sunlight 15
15 Thief Creek 125
COLORADO
*1 Big Thompson 4 5
*2 Estes 45
*3 Flatiron 71 5
*4 Green Mountain 21 6
*5 Marys Lake 8 1
*6 Polehill 33.25
NORTH DAKOTA
1 Garrison 400
SOUTH DAKOTA
1 Big Bend 468
2 Fort Randall 320
3 Gavins Point 100
4 Oahe 595
GENERATING PLANTS
EXISTING & UNDER CONSTRUCTION
POTENTIAL PLANT SITES
BUREAU OF RECLAMATION
U S ARMY ENGINEERS
TRANSMISSION LINES
PICK-SLOAN MISSOURI BASIN PROGRAM
OTHER BUREAU OF RECLAMATION
DOUBLE CIRCUIT LINES
SCALE OF MILES
50 0 50 100 150
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Revised October 1974
Revised & Redrawn by E E O, Billings, Montana-April 1962
MAP No X-W-7
*-Other than Pick-Sloan Missouri Basin Program, but located in Greater Missouri River Basin Area
Shelby
Hovre
Horlem
Rudyard
Tiber
Richardson Coulee
Whotely
Wolf Point
Williston
Westhope
Rolla
Bisbee
Rugby
Minot
Leeds
Devils Lake
Grand Forks
Thief River Falls
Voltoire
Lokota
Poplar
Richland
Wotford City
Great Falls
Lewis & Clark
Killdeer
Woshburn
Garrington
Lewistown
Circle
Dowson County
Glendive
Dickinson
Jamestown
Volley City
Forgo
HELENA
Custer Trail
BISMARCK
De Vaul
Edgeley
Forman
Fergus Falls
Anaconda
Terry
Shirley
Miles City
O'Fallon Creek
Three Forks
Yellowstone River
Billings
Custer
Columbus
Broadus
NORTH DAKOTA
SOUTH DAKOTA
Ellendole
Morris
Benson
ST PAUL
Mobridge
Aberdeen
Groton
Summit
Watertown
Granite Falls
Minnesota River
Mississippi River
Mourine
Eagle Butte
Faith
Sheridan
Lovell
N Cody
Cody
MONTANA
WYOMING
Newell
Ellsworth
Fort Thompson
Huron
Brookings
Monkoto
Rapid City
New Underwood
Wicksville
Woll
Midland
PIERRE
Woonsocket
Flondreau
Buffolo
Gillette
Osage
Hot Springs
Philip
Sioux Falls
MINNESOTA
IOWA
Thermopolis
Mt Vernon
Armour
Mission
Winner
Mortin
Gregory
Beresford
Yorkton
Spencer
Muddy Ridge
Lander
Dove
Johnston
Casper
Lusk
S DAKOTA
NEBR
Niobrara River
Bonesteel
Tyndall
Sioux City
Chodron
O'Neill
Belden
Oenison
Wheotland
Stegall
Gering
Alliance
Boyord
Bridgeport
Rawlins
Sinclair
Medicine Bow
Loromie
Sidney
Kimball
Choppell
North Platte
Ogallala
Grand Island
LINCOLN
Omaho
Creston
IOWA
MISSOURI
Maryville
DES MOINES
WYO
COLO
CHEYENNE
Archer
Pine Bluffs
Julesburg
Holyoke
Muddy Pass
Greeley
Sterling
Beaver Creek
Weld
Yumo
Wray
NEBRASKA
KANSAS
Brighton
Summit
DENVER
Limon
Colorado Springs
Kansas River
TOPEKA
TO HAYDEN CRSP

The cooling pond system is generally utilized in areas where water supplies are somewhat limited. The system operates in the same fashion as once-through cooling except that storage or retention ponds are constructed, and cooling water is recirculated between the pond sites and the condenser unit. Consumptive water losses from the pond system are attributable to both natural evaporation and evaporation induced by the addition of condenser-heated water discharges. Continued water intake must occur to replace evaporative losses from the system.

ST. VRAIN POWER PLANT COOLING POND

Wet cooling tower systems dissipate heat by evaporation. The system is designed to circulate heated water through a naturally or mechanically produced flow of air. As the heated water comes into direct contact with the air draft, large quantities of water are consumed by evaporation.

Dry cooling tower systems operate much like an automobile radiator. Heated water is circulated in a closed system and cooled by a natural or mechanical draft. In areas with insufficient water supplies to support other types of cooling systems, dry tower cooling, which produces no evaporative loss, represents an extremely efficient water conservation and waste heat dissipation method.

Because of the large heat transfer surface area and air volumes required, dry type cooling towers are, however, the most costly of all types of cooling systems to construct and operate. Very few systems of this type are being built or planned in the Missouri River Basin because of the extremely high costs involved. One notable exception is the 330 MW Wyodak plant being built by Black Hills Power and Light Company and Pacific Power and Light Company in Wyodak, Wyoming. When completed, the plant will be the world's largest air-cooled, dry tower electric generating plant.

As stated earlier, the amount of water required for steam electric cooling is partially a function of the cooling system employed and the operating efficiency of the generating plant. Based on plant type and primary efficiency, the Council on Environmental Quality has reported the annual cooling water requirements shown in table 5.

TABLE 5

COOLING WATER REQUIREMENTS FOR A 1000 MW PLANT
(Acre-Feet Per Year)

Cooling Method And Plant Type (Percent Efficiency)	Intake	Direct Consumption (Evaporation)	Discharged
Once-Through			
Nuclear (32)	1,558,000	0	1,558,000
Coal (38)	925,900	0	925,900
Cooling Pond			
Nuclear (32)	47,650	28,600	19,050
Coal (38)	28,300	17,000	11,300
Wet Cooling Tower			
Nuclear (32)	31,020	19,390	11,630
Coal (38)	18,440	11,520	6,920
Dry Cooling 1/			
Nuclear (29.2)	311	0	311
Coal (36.5)	248	0	248

Source: Adopted from: CEQ, Energy Alternatives, 1975: Chapter 12.

1/ Small quantity of make-up water for circulation.

The Council does acknowledge some disagreement with its reported data. For cooling ponds and wet cooling towers, it notes that one research source indicates that wet cooling towers consume 75 percent more water than cooling ponds.

Utilization rates for determining typical water usage for once-through, cooling pond, and cooling tower type systems were developed for use in the U.S. Water Resources Council's Second National Water Assessment. Table 6 shows the usage rates based on a typical 1975 plant of 1,000 megawatts when operated at 100 percent plant load. For lesser plant load factors, the usage rates would be reduced proportionately.

TABLE 6

WATER USE RATES FOR 1000 MW STEAM-ELECTRIC PLANT
(Operating at 100% Plant Factor)

	Once-Through		Cooling Pond		Cooling Tower	
	Nuclear	Fossil	Nuclear	Fossil	Nuclear	Fossil
Plant Heat Rate, Btu/KWh	10,500	8,800	10,500	8,800	10,500	8,800
Condenser Flow[1/], mgd	1,450	899	1,047	649	785	487
Withdrawal, mgd	1,450	899	18	11	27	17
Return Flow, mgd	1,450[2/]	899[2/]	6	4	9	6
Consumption, mgd	9[2/]	6[2/]	12	7	18	11

Source: U.S. Water Resources Council's Second National Water Assessment.

1/ Based on an assumed temperature rise of 13° F for once-through, 18° F for cooling pond, and 24° F for cooling tower.

2/ Evaporation losses which take place after heated cooling water is returned to source.

In addition to the type of cooling system used and the individual plant's level of operating efficiency, regulations governing the discharge of thermal effluents influence cooling water use. The status and significance of limitations on thermal pollution will be briefly reviewed in chapter 5.

Cooling water requirements are closely related to the amount of energy produced. Based on the Federal Power Commission's 1975 plant data for the Missouri River Basin, 4,850.6 mgd of water was withdrawn for condenser cooling use, and 84.5 mgd of the total amount diverted was consumed through heat load induced evaporation. Tables 7 and 8 summarize 1975 electric power cooling water use data for steam-electric plants of all sizes in the basin's 8 subbasins and 11 aggregated subareas (ASA's), respectively. Differences in water withdrawals and consumption in table 8 exist because the 1974 figures represent calculations based on average temperature rise whereas the 1975 numbers represent requirements calculated from actual plant cooling water temperature rise data. Projections of cooling water use through the year 2000 are provided in chapter 3.

TABLE 7

STEAM-ELECTRIC COOLING WATER USE, BY SUBBASIN, 1975

Subbasin	Generation (GWH)	Withdrawal (MGD)	Consumption (MGD)
Upper Missouri	--	--	--
Yellowstone	1,837	90.8	1.8
Western Dakotas	5,384	305.1	7.1
Eastern Dakotas	397	11.4	1.0
Platte-Niobrara	14,950	512.2	23.1
Middle Missouri	13,541	1,670.9	14.1
Kansas River	6,257	400.3	10.2
Lower Missouri	27,313	1,785.3	27.4
TOTAL	69,679	4,776.0	84.7

TABLE 8

STEAM-ELECTRIC COOLING WATER USE, BY ASA, 1974 AND 1975

ASA	Generation (GWH) 1974	Generation (GWH) 1975	Withdrawal (MGD) 1974	Withdrawal (MGD) 1975	Consumption (MGD) 1974	Consumption (MGD) 1975
1001	--	--	--	--	--	--
1002	--	--	--	--	--	--
1003	--	--	--	--	--	--
1004	1,479	1,837	163.9	90.8	1.7	1.8
1005	5,801	5,384	530.6	305.1	7.4	7.1
1006	297	391	13.9	11.4	0.7	1.0
1007	12,038	13,051	443.3	371.8	12.5	20.3
1008	1,613	1,350	97.3	73.8	2.8	2.4
1009	13,246	13,547	1,970.2	1,670.9	13.2	14.1
1010	4,821	5,000	150.1	214.4	5.8	8.7
1011	16,772	16,357	842.0	900.2	13.3	19.4
TOTAL	56,067	56,917	4,211.3	3,638.4	57.4	74.8

NEW PLANT CONSTRUCTION COSTS

The mix of electric generating plant types is governed by a number of factors. Two of the most important are the initial cost to construct a particular type plant and the annual cost to operate the plant. It is typically true that high initial capital cost plants have relatively low annual operating costs. Conversely, if the initial cost of a plant is low, its annual operating cost will be relatively high. Within the Missouri River Basin, an entire range of plant types and capacities are being built. These include nuclear, conventional steam plants fueled by coal or lignite, combustion turbines, conventional hydro, and pumped-storage hydro. Estimated new construction costs for coal, lignite, and nuclear facilities for the 1977 to 1983 period are provided in table 9.

TABLE 9

ESTIMATED CAPITAL COST OF NEW GENERATING FACILITIES

Type of Plant	Denver Area Current Cost ($/kW) 3/	Denver Area Inservice Cost ($/kW) 4/	Kansas City Area Current Cost ($/kW) 3/	Kansas City Area Inservice Cost ($/kW) 4/
2-600 MW Coal Units 1/				
w/SO_2 Equip.	532	603	549	626
w/o SO_2 Equip.	440	499	453	517
2-900 MW Coal Units 1/				
w/SO_2 Equip.	482	548	497	568
w/o SO_2 Equip.	396	451	409	468
2-600 MW Lignite Units 1/				
w/SO_2 Equip.	-	660	-	684
w/o SO_2 Equip.	-	542	-	562
2-1000 MW Per Nuclear Units 2/	607	734	634	776

Source: FPC Capital Cost Simulation Program, FPC correspondence, May 26, 1977

1/ Calculated costs are based on (a) 1/1/77 to 1/1/83 construction period, (b) mechanical draft cooling towers, (c) a 10 percent cost of money, and approximately a 5 1/2 percent escalation in costs during the construction period.

2/ Calculated costs are based on (a) 1/1/77 to 1/1/85 construction period, (b) natural draft cooling towers, (c) a 10 percent cost of money, and (d) approximately a 6 percent escalation in costs during the construction period.

3/ Based on current water and materials costs plus interest on funds used during construction.

4/ Based on escalated costs over construction period plus interest on funds used during construction.

A second set of capital cost requirements has been developed for the Missouri River Basin Commission's Yellowstone Level B Study. For use in the Harza computerized energy model, current construction costs for a baseload coal-fired thermal electric generating plant were estimated at $324,000 per megawatt ($324 per kilowatt) of installed capacity.

THE EFFECTS OF THE RECENT DROUGHT ON MISSOURI RIVER MAIN STEM HYDROELECTRIC POWER PRODUCTION

Energy generation from the Missouri River main stem projects will be near long-term normals in 1977 in spite of drought-level inflows being experienced. Present system operation criteria allow for full-service navigation releases to be continued during the first year of a drought when the reservoir system is at full carryover storage capacity. Estimated energy production for 1977 is projected at 9.0 billion kilowatt-hours. The 1977 forecast level of energy production would almost equal the long-term average energy generation under present levels of depletion. However, due to the above normal inflows experienced during the last few years, the 1977 generation will be much below that of several recent years. Should conditions of normal or less than normal inflow occur next year, some reduction in generation would be expected during 1978.

CHAPTER 3: POWER RESOURCES FOR FUTURE DEVELOPMENT

Chapter 3 provides nationwide projections of growth in total energy needs and of electrical generation from the base year of 1975 to 2000. In addition, it contains a tabulation of planned changes in generating capacity proposed by utilities serving the Missouri River Basin and a listing of those additions to main-stem hydropower currently under active study by the Corps of Engineers.

The additional main stem hydro units reflect those best suited for construction within the next decade. By the turn of the century, additional pumped storage units adjacent to Garrison Reservoir may be warranted, as well as three more conventional hydropower units at the Oahe Reservoir, South Dakota, and four more at Fort Randall Reservoir, South Dakota.

TOTAL ENERGY, ELECTRIC ENERGY, AND NUCLEAR POWER PROJECTIONS FOR THE UNITED STATES-1976

The U.S. Energy Research and Development Administration (ERDA) submitted two annual National Plans for Energy Research, Development, and Demonstration to the President and the Congress in June 1975 and April 1976. In developing the plans, ERDA concluded that the United States must utilize all its energy options in the quest for energy independence. Coal and nuclear power will be paramount energy sources in the nearterm through 1985, and very important in the midterm from 1985 to 2000. In the long-term, it is anticipated that the United States will rely on inexhaustible energy sources such as breeder reactors, commercial solar energy, and fusion power. Other technologies such as individual geothermal and solar heating and cooling systems will act as supplements and also provide backups in the event of failure or delay in the development of the inexhaustible technologies. Conservation, including the improvement of energy efficiency, is most important in using energy as wisely and efficiently as possible and, thus, in reducing demand. The forecasts that follow have been developed in light of these expectations.

The methodology for making current projections for the United States involves the use of five analytical models. These economic and energy models have been individually developed by different energy modeling groups and have been combined into an integrated model for this projection. The models are: the Data Resources Incorporated Macro-economic Growth Model, the Hudson-Jorgenson nine-sector econometric model of interindustry transactions, the Brookhaven National Laboratory-University of Illinois Input-Output Model, the Brookhaven Energy System Optimization Model, and the Bechtel Energy Supply Planning Model.

The basic forecasts conducted by ERDA cover the period 1985 to 2000 and are, therefore, aligned with projections through 1985 made by the Federal Energy Administration. General assumptions adopted for the projections include:

- --The economy continues to grow at normal rates in pursuit of prosperity;
- --World energy prices generally prevail and increase slightly in real terms; and
- --Domestic price regulation and tax policy are selectively used, but market controlled values are not greatly different from postulated market clearing values.

Energy conservation measures are incorporated into the forecasts but not to the extent that these measures would cause significant changes in lifestyles. New technologies must compete with existing technologies based on projected costs and efficiencies of processes; large subsidy programs are not used to bring new technologies into the market place. Rates of implementation for both supply and conservation technologies are normatively assessed based on an analysis of historic technological penetration rates and any special physical constraints on gearing up industrial activity.

Adjustments are made to account for recent legislation that mandates certain energy saving activities and to provide for specific energy choice conversions, such as the direct use of electric energy for space heating and process heating (the precise control of local heat applications in certain industrial fabrication processes).

The macroeconomic projections, using inputs such as population growth, labor productivity, relative prices of capital and labor, and government expenditures, yield a real growth rate in GNP of 3.5 percent for the basic energy forecast cases in the 1985 to 2000 period. The components of GNP are further disaggregated by the interindustry model to provide a set of economic activity values that consume energy. Based on technological coefficients of energy use to satisfy activity requirements, a set of final and end-use demands for energy is developed. The energy patterns to provide the end-use requirements are determined by a resource allocation program with the aid of Reference Energy System network diagram.

The results of this analysis indicate that total energy inputs grow for the most probable energy future from 71 x 10^{15} Btu in 1975 to 97 x 10^{15} Btu in 1985 and 144 x 10^{15} Btu in 2000. This represents an annual average growth rate of about 3.1 percent through 1985 and 2.7 percent from 1985-2000. This total energy growth rate is significantly lower than the 3.7 percent average annual growth rate from post-World War II through the 1973 oil embargo. Higher or lower energy futures are also postulated from different sets of economic and fuel price assumptions and different success rates for energy research, development, and demonstration programs including conservation programs.

The forecast output most pertinent to this projection is the amount of final demand upon the electrical sector. This is where nuclear power is expected to contribute in the foreseeable future. Three electric utility systems have been defined that fit with the energy scenarios analyzed thus far and are expected to be suited to most cases yet to be developed. The case derived from the expected energy forecasts is termed the MID case. The installed electrical generating capacity for this case grows from the current 500 GWe to 725 GWe in 1985 and 1,400 GWe in 2000. HIGH and LOW Case electric utility systems have also been formulated to be coupled with appropriate energy forecasts. Table 10 shows the three utility systems described.

TABLE 10

U.S. ELECTRIC UTILITY SYSTEM
1976 Forecast (Gigawatts Hours/Year Electric)

	LOW Case	MID Case	HIGH Case
1975	500	500	500
1985	715	725	740
2000	1200	1400	1600

In the past, at least until the latest economic recession, electricity production grew at an average annual rate of about 7 percent; the annual growth rate was lower in recession years and higher in expansion years. The fraction of total energy inputs going to the production of electricity has been increasing over the years; in 1975, the production of electricity consumed about 29 percent of total energy inputs. As with total energy, electricity is expected to grow more slowly in the future than in the past particularly as some markets become saturated and adjustments are made in response to expected real price increases. The MID Case shows an average annual growth rate in supply of 3.7 percent between 1975 and 1985 and of 4.4 percent between 1985 and 2000. Electricity production in 2000 is expected to consume about 44 percent of total energy inputs.

The nuclear power contribution to the electric utility system is dependent on several factors among which are the economic competitiveness of nuclear power with fossil fuels, the emergence of new technologies, the closing of the nuclear fuel cycle, and public attitudes. The nuclear power forecast through 1985 is based on an evaluation of plants in operation, under construction, or announced. Variations in the forecasts for this period are caused by applying different degrees of optimism in estimating completion dates for plants under construction. For the period after 1985, each case takes on its own character driven by specific economic, energy, and electricity growth assumptions.

The MID Case reflects assumptions that nuclear power remains economically competitive in many regions of the country, but that new technologies are implemented and conservation measures are successful. The LOW Case is based on the assumption that the nuclear fuel cycle is not closed thus reducing the attractiveness of the nuclear option. The HIGH Case will be coupled with energy forecasts having higher economic growth rates, hence larger total energy and electrical energy requirements. Table 11 gives the installed nuclear capacity associated with these three cases.

TABLE 11

U.S. INSTALLED NUCLEAR CAPACITY
1976 Forecast (Gigawatts Hours/Year Electric)

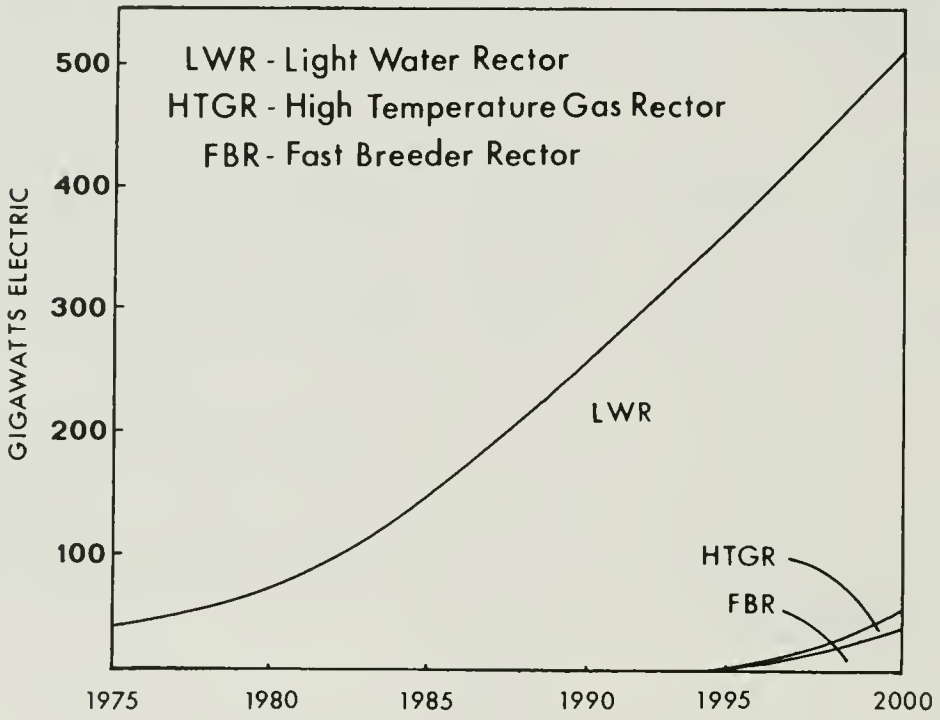
	LOW Case	MID Case	HIGH Case
1975	39	39	39
1980	60	67	71
1985	127	145	166
1990	195	250	290
2000	380	510	620

Reactor Mix

The installed nuclear capacities shown are assigned to the various reactor types using informed estimates of the likely service entrance of each reactor type. Fast breeder reactors are assumed to begin commercial operation in the

United States in 1995. High temperature gas-cooled reactors (HTGR), for which all outstanding orders have been canceled, are assumed to reenter the market in the mid 1990's. The remainder of the plants are light water reactors (LWR) which dominate the reactor mix throughout this century. Figure 5 shows this mix for the MID Case.

Figure 5: 1976 Mid Case Forecast of Installed Nuclear Capacity by Rector Type for United States



PRESENT AND PLANNED GENERATING CAPACITY IN THE MISSOURI RIVER BASIN

By the end of 1975, 23,611 MW of electrical generating capacity was installed and was operational in the Missouri River Basin. In contrast to the amount of available supply, preliminary 1976 revised peak demand projections, that incorporate energy conservation practices, for 1985 and 2000 are shown in table 12. In reality, the requirements may be somewhat lower than the amounts reported in table 12.

TABLE 12

FUTURE PEAK ELECTRIC ENERGY DEMANDS

Year	Peak Demand (MW)
1975	18,700
1985	36,900
2000	78,600

Table 13 shows the potential for expanded hydropower generating capacity at the Fort Peck and Garrison main-stem impoundments. Additionally, scheduled or planned increases in generating capacity for the period 1976 to 1985 are shown in table 14.

A comparison of the 1975 installed (23,611 MW) and planned (21,121 MW) generating capacity totaling 44,732 MW with 1985 projected demand of 36,900 MW indicates that adequate generating capacity is being planned for basin requirements through the near-term time frame. Since the supply figures do not include either basin power imports and exports or main-stem hydropower additions, additional generating capacity could be realized if required. Despite possible delays in initiating plant service by the indicated startup date and problems in distributing generated power, it is evident that sufficient service potential exists to meet electric power requirements within the Missouri River Basin through 1985.

TABLE 13

ADDITIONAL HYDROPOWER POTENTIAL

Item	Fort Peck	Garrison	Total Main Stem	Pumped Storage Fort Randall Gregory County
Number of Units	2	3	5	3
Installed Capacity (MW)	185	272	457	1,180
Dependable Capacity (MW)	196	220	416	1,080
Construction Period (yrs.)	3	3		5
In Service Date	1986	1986		1986
Gross Head (ft.)	168	146		711
Approximate Discharge for Rated Capacity (cfs)				24,700
Existing Plus Potential Units	32,600	70,300		
Existing Units	15,200	40,000		

Source: U.S. Army Corps of Engineers.

TABLE 14

SCHEDULED OR PLANNED CHANGES IN INSTALLED GENERATING CAPACITY, 1976-1985

Plant Name	Capacity (MW)	Type 1/	In-Service (Year)	Location		
				State	County	Subbasin
Ft. St. Vrain	343	NU	1977	CO	Weld	Platte-Niobrara
Pawnee	552	ST	1980	CO	Morgan	Platte-Niobrara
Burlington	100	CT	1977	CO	Kit Carson	Kansas
Valmont	195	CT	1979	CO	Boulder	Platte-Niobrara
Valmont	108	CW	1981	CO	Boulder	Platte-Niobrara
Rawhide	200	ST	1984	CO	Larimer	Platte-Niobrara
Council Bluffs No. 3	650	ST	1978	IA	Pottawattamie	Middle Missouri
Geo. Neal No. 4	576	ST	1979	IA	Woodbury	Middle Missouri
Quindaro	60	CT	1977	KS	Wyandotte	Kansas
Jeffrey No. 1	720	ST	1978	KS	Pottawatomie	Kansas
Jeffrey No. 2	720	ST	1980	KS	Pottawatomie	Kansas
Jeffrey No. 3	720	ST	1982	KS	Pottawatomie	Kansas
Jeffrey No. 4	720	ST	1984	KS	Pottawatomie	Kansas
Nearman	250	ST	1980	KS	Wyandotte	Kansas
LaCygne	685	ST	1977	KS	Lynn	Lower Missouri
Thomas Hill No. 3	600	ST	1981	MO	Randolph	Lower Missouri
Iatan	726	ST	1980	MO	Platte	Middle Missouri
Northeast	130	CT	1977	MO	Jackson	Lower Missouri
Southwest	50	CT	1981	MO	Greene	Lower Missouri
Southwest	250	ST	1985	MO	Greene	Lower Missouri
Greenwood	68	CT	1977	MO	Jackson	Lower Missouri
Greenwood	68	CT	1979	MO	Jackson	Lower Missouri
Greenwood	80	CT	1981	MO	Jackson	Lower Missouri
Greenwood	115	CT	1983	MO	Jackson	Lower Missouri
H. S. Truman	160	HY	1979	MO	Benton	Lower Missouri
Callaway	1194	NU	1982	MO	Callaway	Lower Missouri
Columbia No. 9	30	CT	1980	MO	Boone	Lower Missouri
Columbia No. 10	30	CT	1984	MO	Boone	Lower Missouri
James River	50	CT	1983	MO	Greene	Lower Missouri

TABLE 14 (con't.)

Plant Name	Capacity (MW)	Type 1/	In-Service (Year)	Location		
				State	County	Subbasin
Colstrip No. 3	700	ST	1980	MT	Rosebud	Yellowstone
Colstrip No. 4	700	ST	1981	MT	Rosebud	Yellowstone
Glendive	33	CT	1979	MT	Dawson	Yellowstone
Gentleman No. 1	650	ST	1978	NE	Lincoln	Platte-Niobrara
Gentleman No. 2	600	ST	1981	NE	Lincoln	Platte-Niobrara
Nebraska City	575	ST	1979	NE	Otoe	Middle Missouri
Ft. Calhoun No. 2	1150	NU	2/	NE	Washington	Middle Missouri
Boyd County	334	PS	3/	NE	Boyd	Western Dakotas
Boyd County	668	PS	3/	NE	Boyd	Western Dakotas
Milton Young No. 2	430	ST	1977	ND	Oliver	Western Dakotas
Antelope Valley No. 1	438	ST	1981	ND	Mercer	Western Dakotas
Antelope Valley No. 2	438	ST	1984	ND	Mercer	Western Dakotas
Coal Creek No. 1	550	ST	1978	ND	McLean	Western Dakotas
Coal Creek No. 2	550	St	1979	ND	McLean	Western Dakotas
Coyote No. 1	455	ST	1981	ND	Mercer	Western Dakotas
Coyote No. 2	455	ST	1985	ND	Mercer	Western Dakotas
Lake Preston	30	CT	1978	SD	Kingsbury	Eastern Dakotas
Ben French Nos. 1 and 2	44	CT	1977	SD	Pennington	Western Dakotas
Ben French No. 3	22	CT	1978	SD	Pennington	Western Dakotas
Ben French No. 4	22	CT	1979	SD	Pennington	Western Dakotas
Aberdeen No. 1	28	CT	1978	SD	Brown	Eastern Dakotas
Mitchell No. 1	28	CT	1980	SD	Davison	Eastern Dakotas
Spirit Mound	120	CT	1978	SD	Clay	Eastern Dakotas
Laramie River No. 1	500	ST	1980	WY	Platte	Platte-Niobrara
Laramie River No. 2	500	ST	1980	WY	Platte	Platte-Niobrara
Laramie River No. 3	500	ST	1983	WY	Platte	Platte-Niobrara
Wyodak	440	ST	1978	WY	Campbell	Western Dakotas

1/ NU-nuclear; ST-fossil steam; HY-hydro; CT-combustion turbine; PS-pumped storage; CW-combined cycle, waste hear portion.
2/ Unit deferred pending re-evaluation.
3/ To be determined based on power study underway.

PROJECTED STEAM-ELECTRIC COOLING WATER USE

Projections of basinwide cooling water use by steam-electric generating plants were developed for use in preparing MRBC's regional input to the U.S. Water Resources Council's (WRC) Second National Water Assessment. The projections were developed to conform with aggregated subarea (ASA) boundaries for the 25-year period 1975 to 2000. Figure 6 shows the ASA projection regions, as well as the hydrologic or drainage boundary of the Missouri River Basin. The figure also shows the measured 1975 generation in gigawatt hours and water withdrawals and consumptive uses of water in million gallon days for steam-electric plants of all sizes and plants with 25 MW or greater installed capacity by ASA.

Total ASA (approximately the Missouri River Basin) generation, withdrawal, and consumption amounts are provided in table 15. The basin's ASA totals for fossil and nuclear steam-electric plants with 25 MW and greater installed capacity accounted for 98 percent of generation, 98 percent of water withdrawals, and 97 percent of consumptive water losses in 1975.

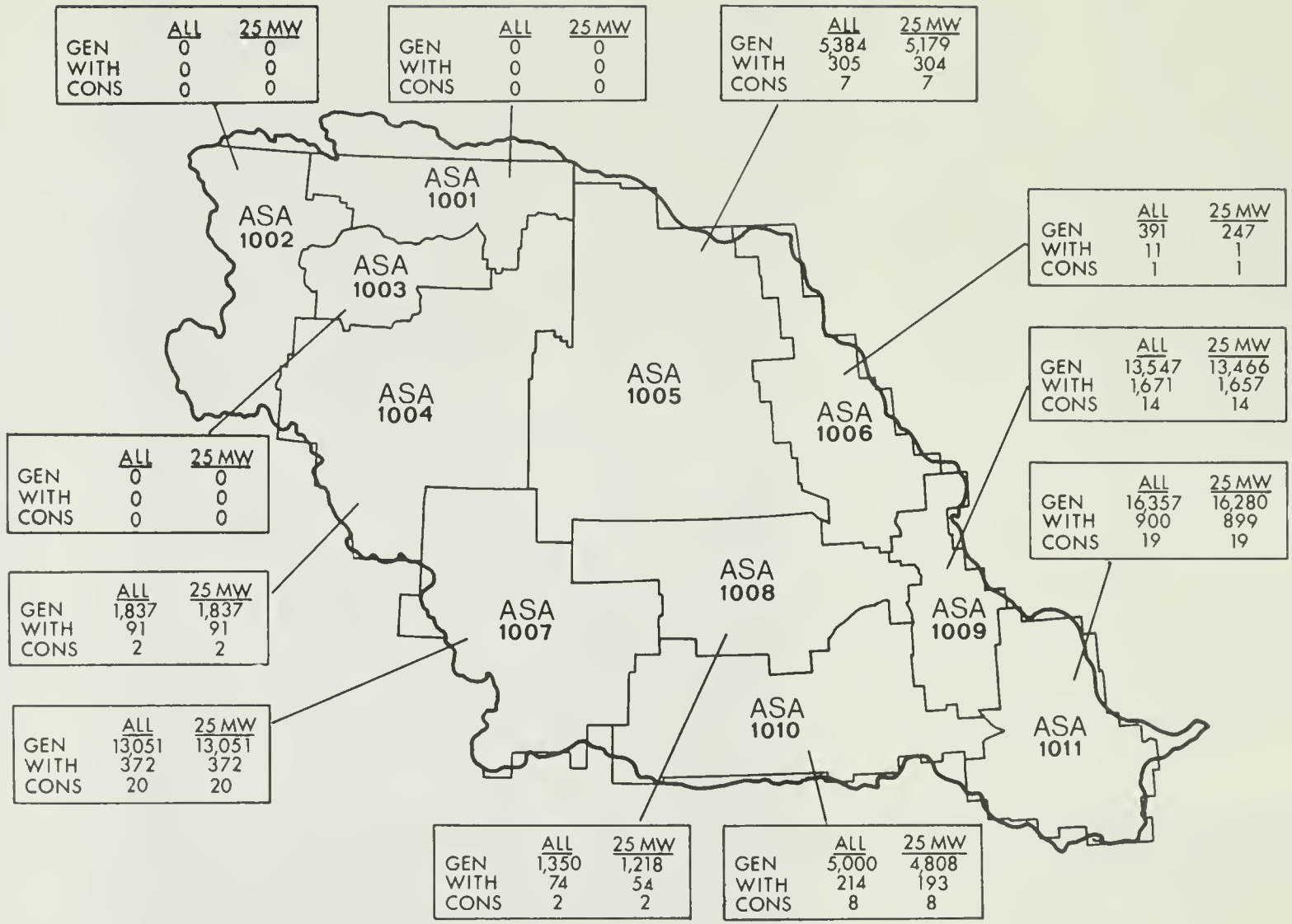
TABLE 15

NET GENERATION, WATER WITHDRAWALS, AND CONSUMPTIVE LOSSES BY SIZE OF PLANT, 1975

	Generation (GWH)	Withdrawals (MGD)	Consumption (MGD)
All Plants	56,917	3,638	75
Plants 25 MW	56,086	3,571	73

Commission projections of water usage by steam-electric generating facilities are rough estimates but do, nonetheless, provide a relatively good indication of future water withdrawals (diversions) and consumptive losses (evaporation). Major factors that can affect the water use projections include the number, size, generation, method of operation (base or peaking), and efficiency of planned electric power plants; the type of condenser cooling system utilized; and the permissible temperature rise in cooling water. Projections of net generation, water withdrawals for cooling, and consumptive water uses for 25 MW and greater capacity steam-electric facilities, developed by the Federal Power Commission for the Missouri River Basin Commission's National Assessment "Technical Memorandum No. 4," are shown for the 11 ASA's in table 16.

Figure 6: Measured Generation, Water Withdrawal and Consumptive Use by Size of Plant and ASA, 1975



LEGEND

GEN - Net Generation in Gigawatt Hours (GWH)
WITH - Water Withdrawals in Million Gallon Days (MGD)
CONS - Water Consumption in Million Gallon Days (MGD)

TABLE 16

GENERATION, WATER WITHDRAWAL, AND CONSUMPTION PROJECTIONS FOR 25 MW AND LARGER PLANTS BY ASA

ASA Location	1975			1985			2000		
	GEN(GWh)	WITH(MGD)	CONS(MGD)	GEN(GWh)	WITH(MGD)	CONS(MGD)	GEN(GWh)	WITH(MGD)	CONS(MGD)
ASA 1001	0	0	0	0	0	0	0	0	0
ASA 1002	0	0	0	0	0	0	0	0	0
ASA 1003	0	0	0	0	0	0	0	0	0
ASA 1004	1,837	91	2	19,248	141	34	33,845	127	51
ASA 1005	5,179	304	7	19,223	1,154	21	88,272	1,476	97
ASA 1006	247	1	1	131	0	0	100	0	0
ASA 1007	13,051	372	20	35,390	377	51	98,050	423	162
ASA 1008	1,218	54	2	4,788	560	3	22,206	339	40
ASA 1009	13,466	1,657	14	27,969	2,396	33	47,780	1,441	72
ASA 1010	4,808	193	8	17,254	69	26	48,350	76	50
ASA 1011	16,280	899	19	48,622	1,137	71	95,949	1,056	165
TOTAL	56,086	3,571	73	172,625	5,834	239	434,552	4,938	637

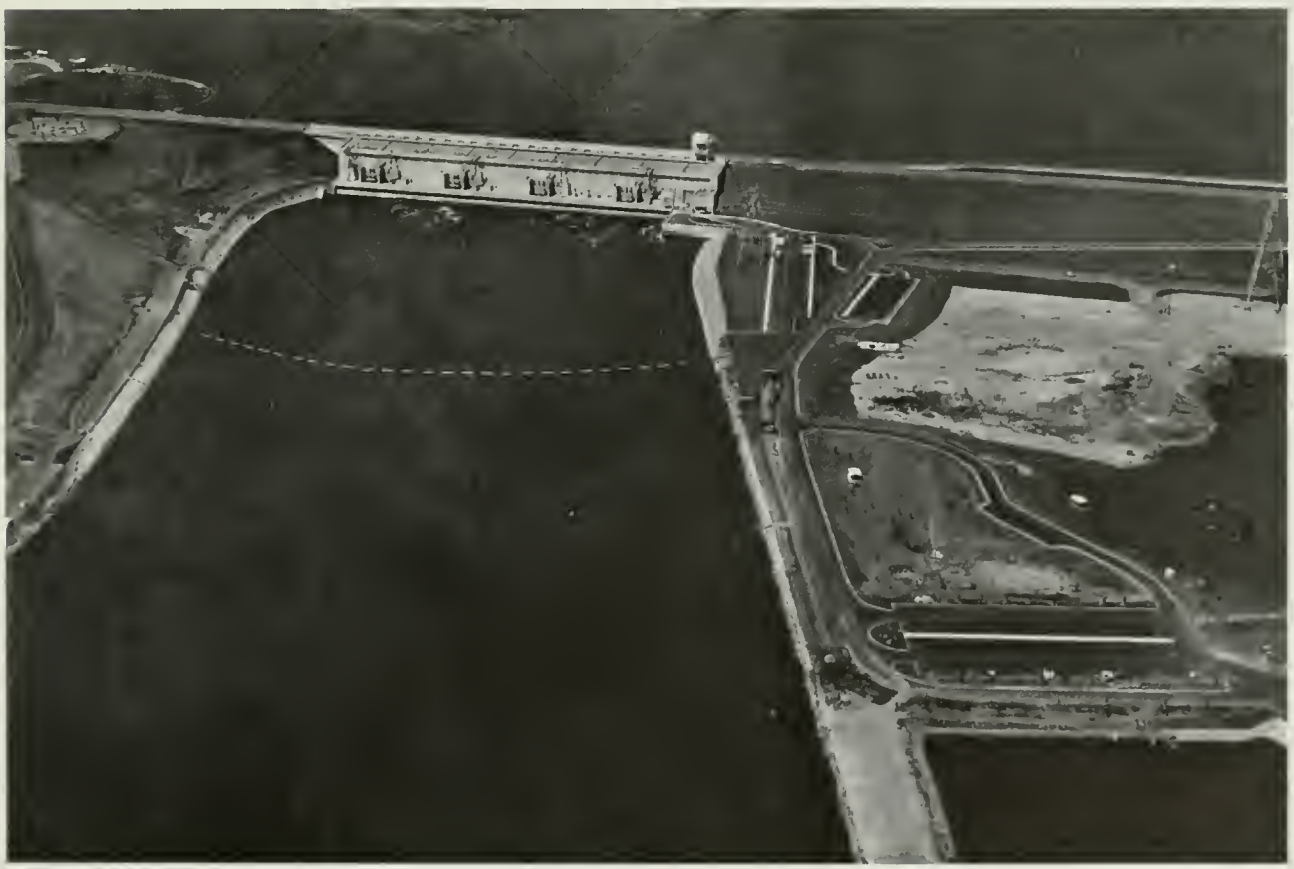
U.S. Army Corps of Engineers

- Missouri River - South Dakota, Nebraska, North Dakota, Montana

The Corps' draft Umbrella Study report for the Upper Missouri River, completed in mid-1977, provides several near-term and long-term hydropower recommendations important to the Missouri River Basin's electric energy situation. The near-term recommendations include:

1. The conversion of two flood control tunnels at Fort Peck, Montana, and three flood control tunnels at Garrison, North Dakota, for the production of 185 MW and 272 MW of additional power capacity, respectively.

2. The construction of a 1,180-MW pumped-storage hydro site adjacent to Lake Francis Case, known as the Gregory County site, in South Dakota to utilize available off-peak energy sources for pumping.



BIG BEND DAM POWERHOUSE AND TAILWATER AREA

Long-term recommendations include:

1. Deferral of possible long-term power additions of 144 MW at Oahe Dam and 282 MW at Fort Randall Dam for restudy until less uncertainty exists on the possibility for and amount of future water depletions.

2. Deferral of a pumped-storage site adjacent to Lake Sakakawea, North Dakota, with a capacity of more than 1000 MW, pending long-term development of alternative energy supplies required for off-peak pumping cycles.

3. More detailed studies of a large number of pumped-storage sites having sufficient hydraulic heads for 500 MW or greater production that have already been studied under reconnaissance-type studies. Further analysis will be required during the mid-1980's to determine the long-term feasibility of these potential sites.

- National Hydroelectric Survey

Section 167 of the Water Resources Development Act of 1976 (P.L. 94-587) directed the Army Corps of Engineers to undertake a comprehensive national study of hydroelectric power resources, including the potential for pump-storage and low-head installations, regional power supplies, efficient utilization of output, and additional installations at existing projects. The survey, inventory, and analysis phases of the study are to be conducted over a 2- or 3-year period and are to begin in 1978.

U.S. Bureau of Reclamation

- Western Energy Expansion Study

The Bureau of Reclamation (USBR) has completed its assessment of opportunities for additional electrical power and energy in the West and has published its findings in a report titled "Report on the Western Energy Expansion Study - February 1977." The Western Energy Expansion Study (WEES) was conducted to identify and evaluate opportunities for increased electrical power and energy generation in the 17 Western States that warrant further, more detailed study in the immediate future. The focus of the study was primarily on development of hydroelectric power, including pumped-storage, at both new sites and existing facilities. Other opportunities that were studied related to the development of electrical energy using solar (direct radiation and wind) and geothermal resources. In addition to developmental opportunities, matters of a policy nature were also discussed and evaluated.

The 17 Western States in which the Bureau of Reclamation is active in water and land resources planning and development contain a significant number of the remaining undeveloped hydroelectric power sites in the continental United States. The region also has the most promising sites for electrical energy development from both direct solar radiation and wind and almost all of the potential electrical energy development from geothermal resources.

During the WEES investigation, all seven of USBR's regional offices identified opportunities for development, made preliminary evaluations of these opportunities, and formulated proposals for future study of these opportunities. A study team then conducted a comparative evaluation of all study proposals, formulated additional proposals, and arrived at the conclusions and recommendations presented in the report.

A number of observations and general conclusions were drawn from the study:

1. Hydroelectric powerplants use a renewable resource, have long-term dependability, and are particularly suited to peaking power operation because of their capability of responding rapidly to changes in demand. As an alternative to peaking power generated by oil and natural gas, the continued development of hydroelectric power can contribute to the con-

servation of scarce petroleum fuel supplies and, in many cases, can prove more environmentally acceptable. Moreover, the power produced is less subject to price inflation when compared to power produced from oil and natural gas.

2. A number of opportunities exist for continued development of hydroelectric power in the West.

3. Uprating existing hydroelectric generator and turbine units at USBR powerplants may be one of the most immediate, cost effective, and acceptable means of developing additional electrical power in the West.

4. Addition of powerplants at existing USBR facilities and enlargement of present powerplants are very attractive means of developing additional electrical power and energy.

5. Cooperative development of large pumped-storage facilities, which can be integrated into private and Federal transmission systems, holds high promise for effecting savings of oil and natural gas resources by permitting substitution of coal and nuclear resources for more scarce fuels.

6. A nationwide inventory of potential hydroelectric and pumped-storage sites could provide valuable information for decisionmakers at the Federal, State, and local levels. Such inventories would result in a more reliable assessment of the regional and national hydroelectric reserves for future reference and possible substitution for diminishing petroleum fuel resources.

7. Substantial contributions can be made to the commercialization of electrical energy from direct solar radiation, wind, and geothermal resources through integration with USBR power systems.

In accordance with the general conclusions given above, it was recommended that USBR initiate an accelerated program for investigation of additional electrical power and energy development in the West. In this accelerated program, highest priority should be given to uprating existing USBR developments. Immediate consideration should be given to appraisal and feasibility studies of large pumped-storage hydroelectric plants. Hydroelectric and pumped-storage inventories, studies of a policy nature, and studies of possible integration of solar and geothermal energy into USBR power systems should also receive early study.

During the study, a total of 127 study proposals were considered and evaluated throughout the 17-State Western area. Of this total number, it was concluded that 61 proposals are appropriate for further study. Nine of the projects recommended for further study (six conventional and three pumped-storage) are located in the Missouri River Basin and are listed in table 17.

In addition to the above hydro-resources, the study also recommended that USBR's organizational capabilities be used to assist in commercialization of solar and geothermal energy resources in the West. The development of these resources, in conjunction with water storage and power transmission systems which are operated by USBR, could demonstrate the viability and enhance the possibility of integrating these potentially important renewable energy sources with conventional power systems. A preliminary assessment of a solar power application (wind) in the Medicine Bow area of Wyoming has shown potential for further study. This is the only such site currently under consideration in the Missouri River Basin.

TABLE 17

WEES MISSOURI RIVER BASIN RECOMMENDATIONS

Site-specific conventional hydroelectric developments

Site Description/Name	State	Type of Dev.[1/]	Capacity (MW)	Net Annual Generation (GWH)
Yellowtail Afterbay Powerplant	MT	LOWH	11.4	56.0
Timber Dam Powerplant	MT	HY-A	5.0	39.4
Lonetree Powerplant	ND	HY-A	16.0	86.9
Carter Lake - St. Vrain Powerplant	CO	LOWH	4.0	5.0
Canyon Ferry Powerplant Addition	MT	HY-A	90.0	70.0
Fort Benton Unit (Baseload)	MT	HY-N	160.0	760.0

Site-specific pumped-storage developments

Description	State	Type of Dev.[2/]	Capacity (MW)	Average Annual Gen. (GWH)	Average Annual Pump. (GWH)	Net Average Annual Gen. (GWH)
North Platte Hydroelectric Study (Alcova and Kortes Pumped-Storage Plants)	WY	PS-A	800	1,600	2,400	-800
Pinewood-Carter Pumped-Storage Plant	CO	PS-A	200	300	450	-150

1/ HY-A = Conventional Hydroelectric Powerplants - Additions at Existing Reclamation Facilities
HY-N = Conventional Hydroelectric Powerplants - All New Facilities
LOWH = Low-head Hydroelectric Powerplants
2/ PS-A = Pumped-storage Powerplants - At Existing Reclamation Facilities

Missouri River Basin Commission

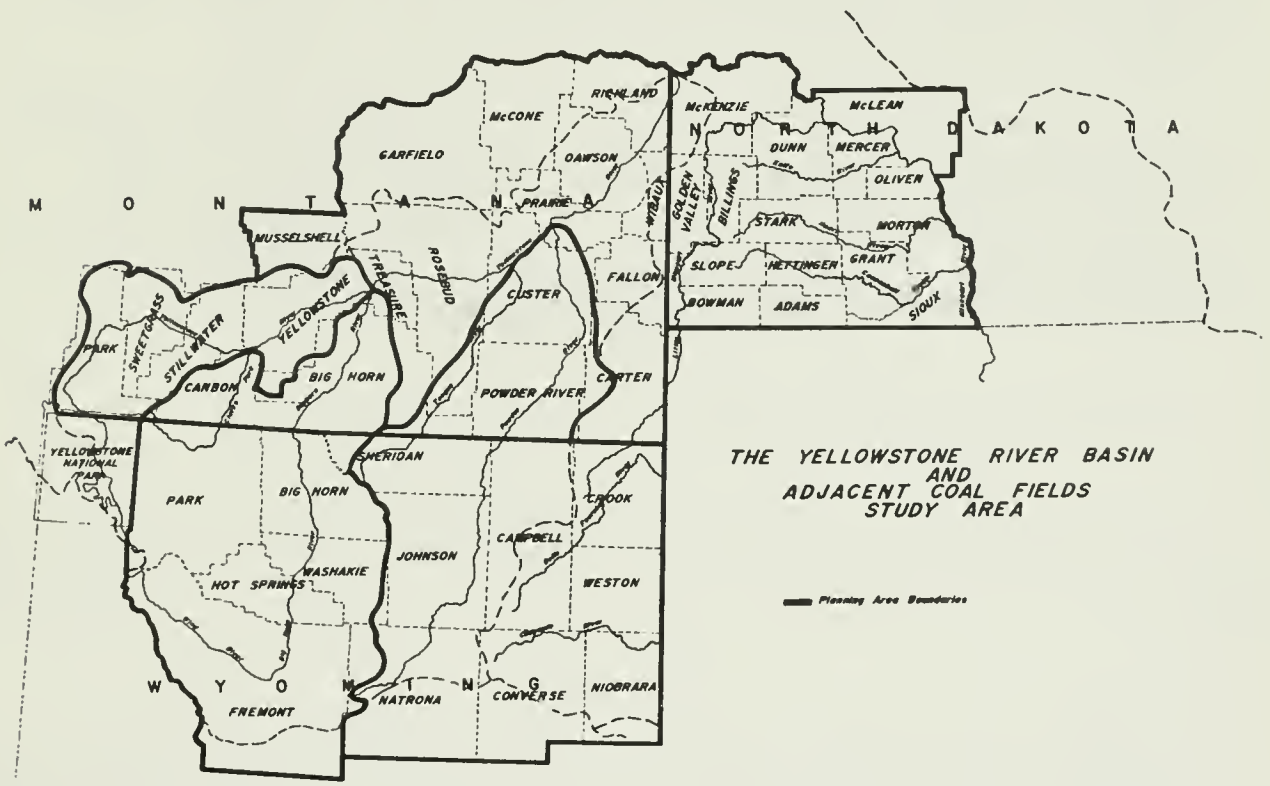
- Yellowstone Basin and Adjacent Coal Areas Level B Study

The Missouri River Basin Commission initiated a major resource study of the 51-county Yellowstone River Basin and adjacent coal field areas of Montana, Wyoming, and North Dakota (figure 7) in 1976. The purpose of the multiagency planning effort is to identify alternatives and recommend a comprehensive water and related land resource management plan for the three-State coal area. Study participants include, in addition to the MRBC, the U.S. Department of the Interior, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Department of Agriculture, and the States of Montana, North Dakota, and Wyoming.

Major problems and issues under examination as a part of the study include conflicts over the increasing utilization of and competition for both instream and off-stream uses of available surface water supplies; the impact of coal development and attendant rapid growth on the service facilities and socio-economic structure of local communities; the loss of agricultural and scenic resources; the possible degradation of fragile terrestrial and aquatic ecosystems; increases in air and water pollution; and the significant issue of Indian water rights.

As an extremely important component of the level B study, the Commission contracted with Harza Engineering Company to develop a computerized model that would estimate energy-related demands for water, labor, land, capital, and coal resources in the Yellowstone study area under alternative regional energy development scenarios. The Harza model also measures energy-related particulate, sulfur oxide, and nitrogen oxide emissions and analyzes various transportation system alternatives.

Figure 7: Yellowstone Level B Study Area



The Harza simulation effort was completed and a report provided to the MRBC in late 1976. Detailed information on the model is available from the Commission in a 1976 report entitled "Analysis of Energy Projections and Implication for Resource Requirements." Completion of the level B field study is anticipated by February 1978.

- Section 13(a) Coal Technology Assessment

During 1977, the Missouri River Basin Commission was requested by the U.S. Water Resources Council (WRC) to conduct a regional reconnaissance-level study of the primary costs, constraints, and water-related social, environmental, and economic impacts that will result from the commitment of water to the future development of alternative coal technologies in parts of four basin States--Montana, North Dakota, South Dakota, and Wyoming. In addition to addressing the preceding questions, the study will also review, to the extent possible, the impacts of changes in water availability and water quality on the Missouri River main stem downstream from the four-State study area.

The Commission's water resource assessment study of alternative coal development technologies in the Upper Missouri River Basin is being conducted under the authority granted to the Energy Research and Development Administration (ERDA) by Section 13(a) of the Nonnuclear Energy Research and Development Act of 1974 (Public Law 93-577). The study results, when submitted to WRC, will represent an important contribution to ERDA's continuing program activities and in particular, the preparation of forthcoming National Energy Research, Development, and Demonstration Plans and section 13(b) and 13(c) assessment studies. Completion of the study will also contribute to MRBC's ongoing planning and coordination activities.

Three other regional assessments, in addition to the MRBC-led study, are to be conducted in other parts of the country. The three include two studies in Colorado and one in the Ohio River Basin. The MRBC Energy and Water Committee has been designated to serve as the Steering Committee for the four-State study. Other participants in the study tentatively include agencies from the Departments of Agriculture, the Army, and the Interior; the U.S. Environmental Protection Agency; and representatives from the States of Montana, North Dakota, South Dakota, and Wyoming.

CHAPTER 4: ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAMS

The Energy Research and Development Administration (ERDA) completed its second year of operation in 1976 as the major Federal agency charged with developing all energy sources and alternative energy technologies necessary to make the Nation self-sufficient in energy. Explicit in this agency goal is another commitment: to protect the Nation's environmental quality, health, and safety. The preservation of land, water, and air resources as well as human health is given high priority. Thus, as new energy technologies evolve, a careful examination of the problems of water availability, water quality, and water requirements is needed and innovative approaches to water research and assessment are required to ensure that new and expanding energy systems will be technically feasible and publicly acceptable.

An important corollary to ERDA's Research and Development (R&D) program is the statutory responsibility to provide to the Congress and to the public each year a National Plan for Energy Research, Development, and Demonstration. This annual plan is based on ERDA's five national missions related to energy:

1. To maintain the security and policy independence of the Nation.

2. To maintain a strong and healthy economy, provide adequate opportunities, and allow fulfillment of economic aspirations, particularly for those citizens who are at the lower end of the socio-economic scale.

3. To provide for future needs so that future lifestyles remain a matter of individual choice and are not limited by the unavailability of energy.

4. To contribute to world stability through cooperative international efforts in the energy sphere.

5. To protect and improve the Nation's environmental quality by ensuring that the preservation of land, water, and air resources is given high priority.

The following material highlights accomplishments or significant developments in ERDA's overall 1976 R&D program, namely in the areas of fossil energy, nuclear energy, solar-wind and advanced fuels, energy conservation, and environment and safety.

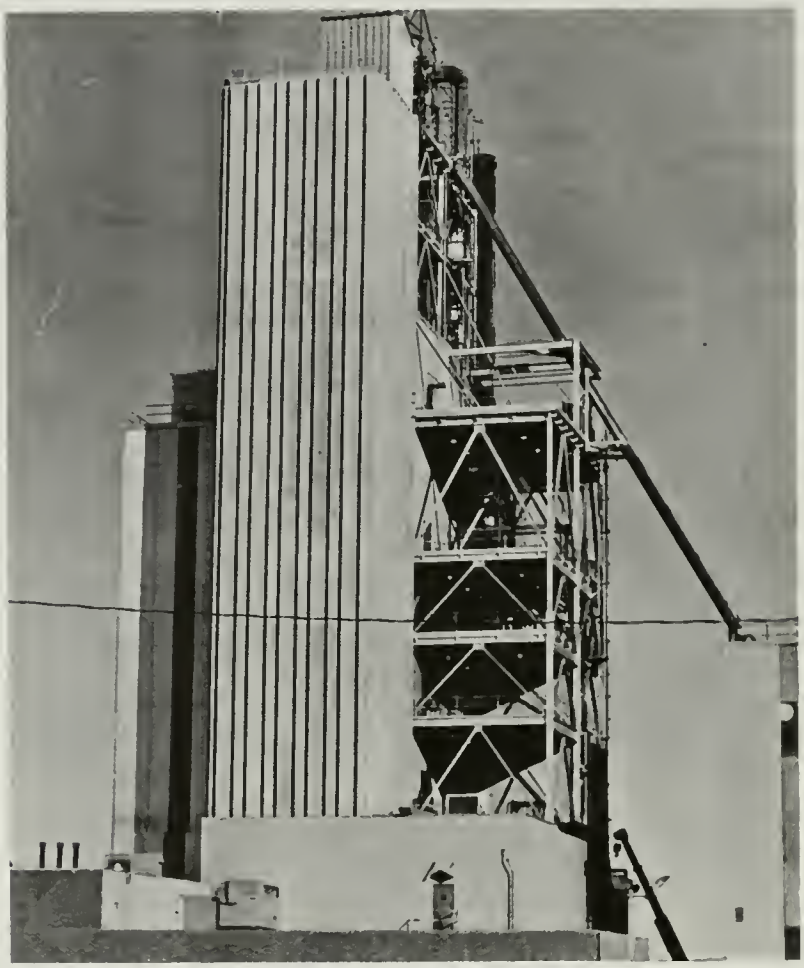
FOSSIL FUELS

In 1976, coal conversion technology continued to lead the way in ERDA's fossil fuel development and demonstration programs. In addition to advanced coal conversion, the fossil fuels program includes petroleum and natural gas, oil shales, and biomass development.

Coal Resources

ERDA's Office of Fossil Energy dedicated three coal conversion plants in 1976. One plant located in Tacoma, Washington, is a solvent-refined coal (liquefaction) pilot plant. Another near Homer City, Pennsylvania, is known as a Bi-Gas Coal Gasification Pilot Plant. The third plant--the H-Coal pilot

plant (liquefaction) with a capacity of 600 tons of coal per day--is located in Catlettsburg, Kentucky. In addition, successful operation continued at two gasification plants--the CO_2 Acceptor at Rapid City, South Dakota, and HYGAS in Chicago, Illinois.



CO_2 ACCEPTER COAL GASIFICATION PROCESS PILOT PLANT RAPID CITY, SOUTH DAKOTA

Contract negotiations have been initiated by ERDA for the design of two demonstration plants to convert coal to high-BTU pipeline gas. Each study represents the first phase of a projected 8-year design, construction, and operation program and should take about 20 months to complete. This program will use advanced, or second-generation, technologies to produce clean-burning, high-Btu synthetic gas, which could be fed directly into the Nation's pipelines.

Contract negotiations have been initiated by ERDA for the design of two demonstration plants to convert coal to low-Btu fuel gas for large scale industrial uses. Each study is expected to take approximately 21 months to complete and will include a conceptual design and evaluation of a commercial plant.

The University of Minnesota, Minneapolis, was selected by ERDA to negotiate a cost sharing contract for the design, construction, and operation of a low-Btu coal gasifier. The gasifier will be installed at the University's Duluth campus to supply a fuel substitute for natural gas or oil that will be capable of firing a boiler for space heating this institution. The economic and technical data derived from the operation of this coal gasification system could provide the basis for other potential applied uses of this technology as an alternate near-term source of fuel.

ERDA has awarded four contracts to build and operate fluidized-bed combustors for the clean burning of coal in industrial steam generators, boilers, and heaters. In a related development, construction has been completed on a 30-megawatt fluidized-bed boiler at Rivesville, West Virginia, to produce electricity for the Monongahela Power Company system.

Oil Shale Resource

Two important oil shale recovery technology activities have recently been undertaken. First, contract negotiations have been initiated by ERDA with four firms to develop technology for in-situ (in place) oil shale recovery. One important objective of the program is to demonstrate the best fracturing or explosive technique to obtain desired results.

Second, the Laramie Energy Research Center (LERC) has successfully extracted oil from an underground oil shale formation near Rock Springs, Wyoming. After working on the experimental project for the last three years, LERC researchers are now collecting oil at a constant rate, together with gas having a heating value of about 70 Btu per cubic foot, from six wells.

MHD Development

An industrial park 5 miles south of Butte, Montana, has been selected as the site for the Montana Magnetohydrodynamics (MHD) Component Development and Integration Facility (CDIF). This facility will be used to perform engineering development and proof testing of prototype MHD components on a small scale (30-50 MW thermal). In MHD power generation, coal is converted to a high temperature gas. A seed, such as potassium carbonate, is added to the hot gas--called plasma--to make it electrically conductive. As the plasma moves at a high velocity through a magnetic field, it produces electricity with minimal pollution. This technology is anticipated to reach commercialization in the late 1980's.

NUCLEAR ENERGY

With the election of a new President in 1976, major changes were indicated for U.S. domestic nuclear energy policies and programs. When the National Energy Plan was issued on April 29, 1977, it stated, for example, that the President proposed to cancel construction of the Clinch River Breeder Reactor (CRBR) project and all component construction, licensing, and commercialization efforts, and that only a base level program would be maintained. Other policy statements regarding nuclear energy development, uranium resources, production, and prices for 1976 are described below.

U.S. Nuclear Policy

On April 7, 1977, President Carter announced a number of decisions based on the risk that components of the nuclear power process could be turned to providing atomic weapons. Specific decisions included:

- The indefinite deferment of commercial reprocessing and recycling of plutonium.

- Restructuring the liquid-metal fast breeder reactor program to give reactor priority to alternative designs, and deferring commercialization of the fast breeder.

- Redirecting funding of nuclear research and development programs to accelerate research into alternative nuclear fuel cycles that do not involve direct access to materials usable in nuclear weapons.

- Increasing production capacity for enriched uranium for domestic and foreign needs.

- Proposing necessary legislative steps to permit the United States to offer nuclear fuel supply contracts and to guarantee delivery of such fuels to other countries.

- Continuing to embargo the export of equipment or technology that would permit uranium enrichment and chemical reprocessing.

1976 Summary of U.S. Uranium Resources

The increasing commitment to the use of light water nuclear power reactors both in the United States and worldwide during the past 10 years has created a large demand for a uranium fuel supply. Currently, the U.S. Government estimates a domestic uranium resource base of about 3.7 million tons of U_3O_8 (table 18).

TABLE 18

U.S. URANIUM RESOURCES, January 1, 1976
(Tons U_3O_8)

$/Lb. U_3O_8 Cutoff Cost	Reserves	Potential			
		Probable	Possible	Speculative	Total
$30	640,000	1,060,000	1,270,000	590,000	3,560,000
Byproduct[1/] 1975-2000	140,000	--	--	--	140,000
TOTAL	780,000	1,060,000	1,270,000	590,000	3,700,000

1/ Byproduct of Phosphate and Copper Production.

Most known U.S. uranium resources are located in small areas of six States. The bulk of present U.S. uranium resources is in the Grants Mineral Belt of New Mexico, in a few basins in central Wyoming, and in the Gulf Coastal Plain in Texas. The geographic distribution of probable, possible, and speculative potential U.S. uranium resources recoverable at $30 per pound of U_3O_8 is shown in figure 8. In 1976, uranium delivery prices averaged about $12 per pound of U_3O_8, but prices for deliveries in the 1982-85 time period are expected to average about $20 per pound.

In 1976, ERDA-reported uranium concentrate production in the United States was 12,700 tons of U_3O_8, an increase of 1,200 tons over 1975. The ore processed and concentrate produced in 1975 is shown by States in table 19.

Figure 8: Potential Uranium Resources by Region ($30/lb. U_3O_8)

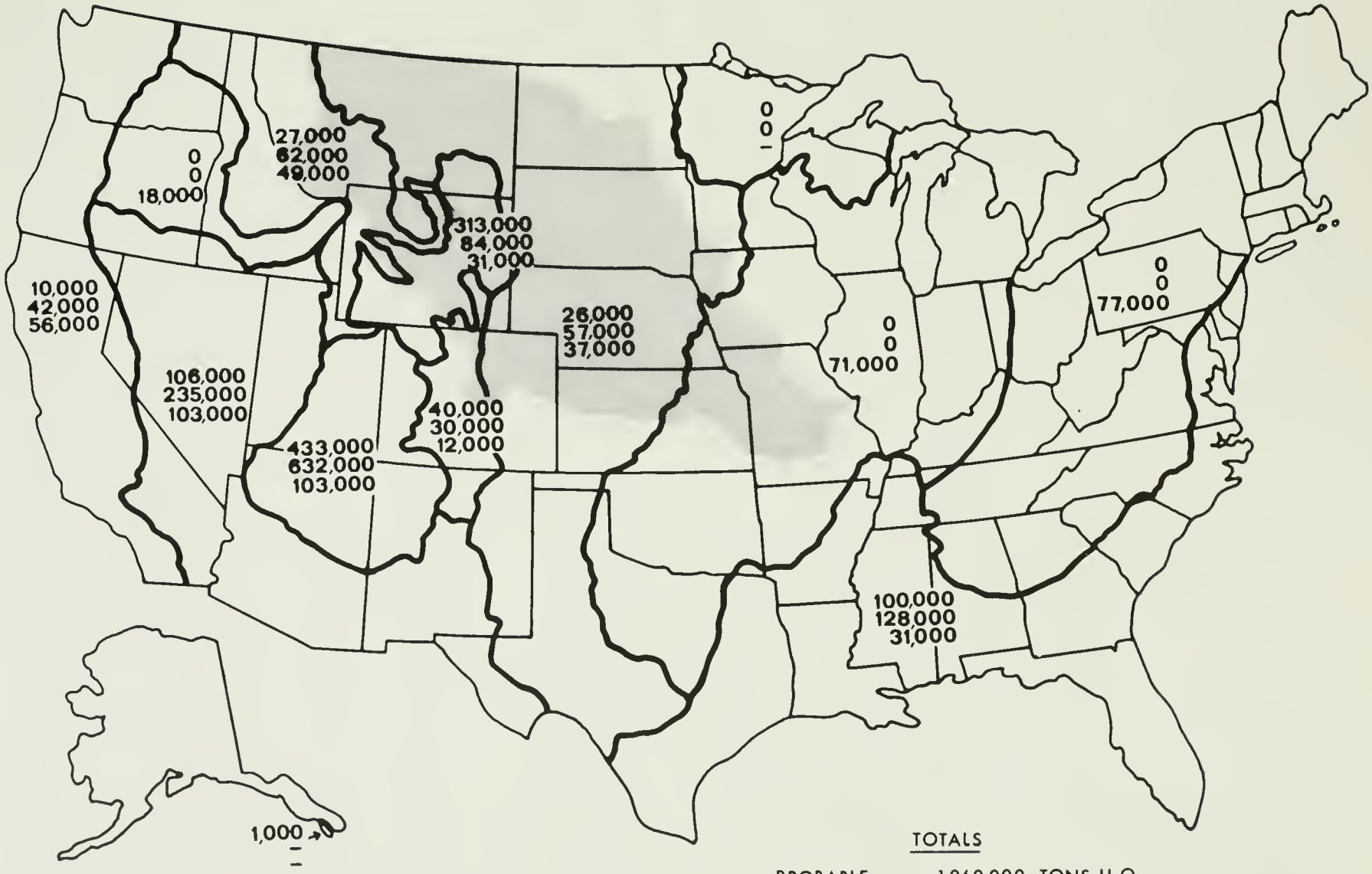


TABLE 19

ORE PROCESSED

State	Million Tons	Tons of U_3O_8 Contained	Concentrate Produced Tons of U_3O_8 Contained
New Mexico	3.4	6,400	6,100
Wyoming	3.3	4,400	4,000
Others: (CO, TX, UT, & WA)	2.2	2,900	2,600
TOTAL	8.9	13,700	12,700[1/]

1/ Includes 200 tons of U_3O_8 from mine waters, heap leaching, and solution mining.

Conventional Nuclear Reactor Programs

A new technique that increases nuclear power plant productivity, by reducing plant inspection downtime, has been successfully demonstrated by ERDA. Pressurized water reactor steam generators are routinely inspected every 12 to 18 months when they are shutdown for refueling. A redesigned probe used for inspection of the steam generator tubes has reduced inspection time by 2 1/2 days. Demonstration of this technique was conducted during a refueling shutdown of the Duke Power Company's Oconee Nuclear Station Unit 3 at Seneca, South Carolina.

In addition, a gas-cooled reactor technology commercialization study, funded by both private industry and ERDA, was undertaken to help ERDA plan its various gas reactor concept activities. Work continues on the gas-cooled fast breeder reactor concept which has a potential for low cost electrical generation.

Breeder Reactor Programs

A March 1977 review of the U.S. Liquid Metal Fast Breeder Reactor Program (LMFBR) has been completed by a 12-man steering committee appointed by ERDA. The review was requested by the new Administration and focused on the role of the LMFBR in meeting U.S. energy requirements. The summary report concluded that the U.S. should:

- Preserve the nuclear fission option for the long term.
- Research other reactor technologies that are more consistent with nonproliferation objectives.
- Recognize that there is no totally proliferation-proof fission option.

Commercial Nuclear Waste Disposal

At the present time, nuclear energy generates about 10 percent of the electricity used in the United States. This is expected to increase to about 20 to 25 percent by 1985 as the Nation attempts to free itself from an increasing dependence on foreign oil. With nuclear power included as an integral part of the electric utility industry's plans, the timely construction of radioactive waste repositories is vital.

On October 28, 1976, the President directed that efforts be made "to speed up the program to demonstrate all components of waste management technology by 1978, and to demonstrate a complete repository for commercial high-level nuclear wastes by 1985."

In order to gather preliminary geologic data on the suitability of various formations for a waste repository, ERDA is expanding its study of deep underground formations within the continental United States. Geologic formations of interest are located beneath 45 of the 48 mainland States. Studies will be conducted in 36 of these States during the fiscal year 1977 program.

Field work, including some core drilling, will be conducted along with geologic literature studies in 13 of the 36 States. Included in this group is the State of South Dakota. Geologic literature studies and possible field work will also be performed in six other States, including Minnesota and North Dakota. (Information about these 6 States is not as complete as that for the first 13 States.) For the remaining 17 States, only geologic literature studies will be done. These include the States of Missouri, Montana, Nebraska, and Wyoming.

Geologic disposal involves placement of wastes deep underground in stable formations that have remained unchanged for long periods of time. Geologic formations to be studied and evaluated include: bedded salt in Western and Midwestern States; salt domes in Gulf Coast States; shales, which are widely distributed over the Nation; and a wide variety of granite and other crystalline rocks.

Up to six nuclear waste repositories, several thousand feet below the earth's surface and located in various regions of the country, may be constructed to isolate the waste fission products of nuclear power reactors. Each repository will be designed to receive either used nuclear fuel rods removed from nuclear reactors or solidified waste resulting from the reprocessing of spent fuels rods.

SOLAR-WIND-ADVANCED SYSTEMS

Several research and development programs to advance solar and wind technologies are taking place in the Missouri River Basin States. The following programs represent the more important activities in these fields.

Solar Energy

ERDA is funding about 17 experiments to test solar drying of corn, wheat, rice, forage, peanuts, and other agricultural products at universities and experimental farms in 14 States. At present, solar energy is best used to replace slow, low-temperature gas-drying methods, in which the drying air needs to be only 5 to 10 degrees warmer than the outdoor air. As in conventional drying, warm air is circulated through the wet grain to evaporate moisture.

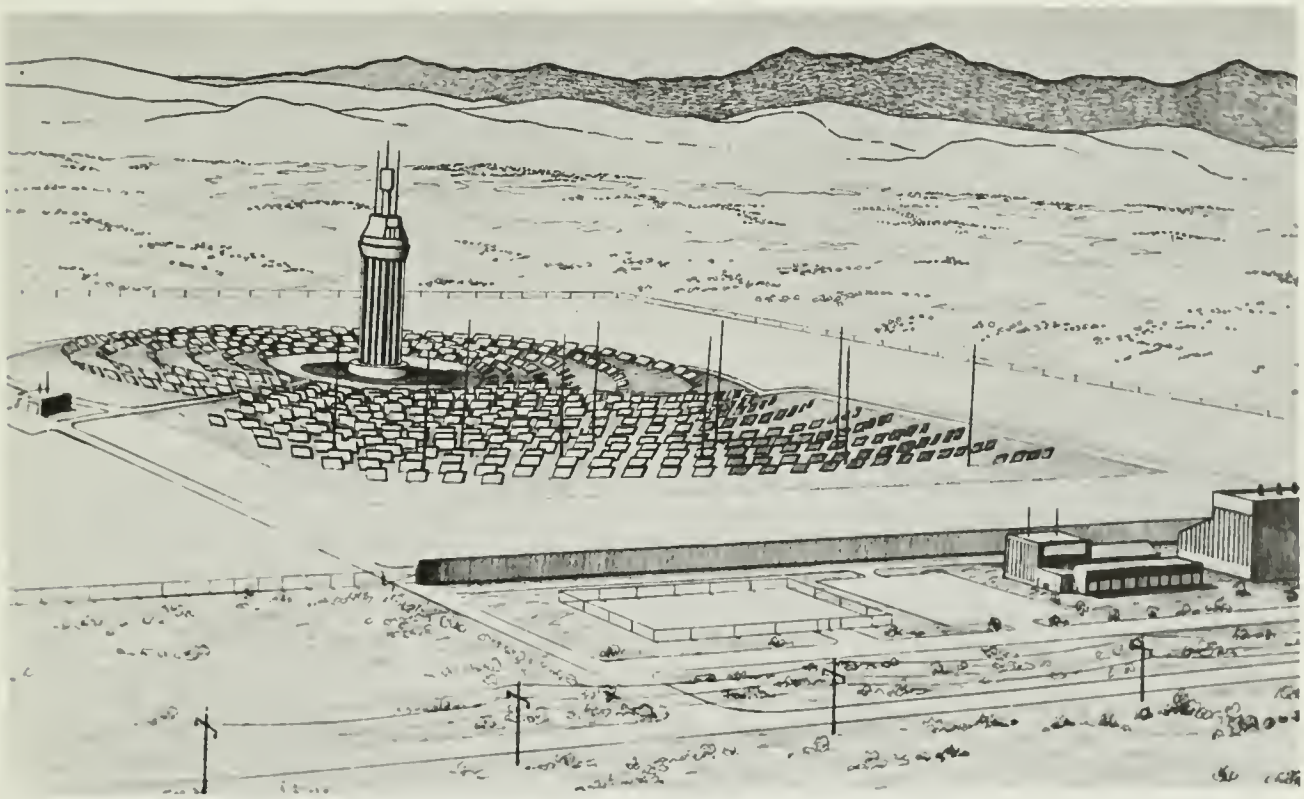
A durable commercial solar drying system costs about $2,000 and results in fuel savings of about $100 a year. To overcome this high cost-benefit ratio, ERDA has suggested development of a multiple-use solar system. One such unit could dry grain in the fall; heat the farmhouse, livestock shelters, and greenhouses; and provide hot water for household and farm use (such as washing milking machines).

An ERDA-supported study indicates that solar heating may now compete economically with electric baseboard heating in private dwellings. The study was concerned with fuel costs, weather conditions, and cost of ownership in 13 major population centers of the United States, including Bismarck, North Dakota; Columbia, Missouri; and Madison, Wisconsin. The study assumed that a typical installed solar system today costs the equivalent of $20 per-square-foot of flat-plate collectors used in the system, and that optimum collector sizes generally range from 20 to 30 percent of the square footage of the house,

depending on local conditions. Thus, the $20 per-square-foot cost would mean a price of $6,000 to $9,000 for a well-insulated residence with 1,500 square feet of living space. The study concluded, therefore, that if the solar system could be purchased for $15 per square foot, it would be competitive with electric heat pumps in Bismarck, Grand Junction, Los Angeles, Madison, and New York City; and with oil in Atlanta, Bismarck, Charleston, Grand Junction, Los Angeles, and Miami. If the solar system purchase price dropped to $10 a square foot by 1980, solar could be competitive with oil in all 13 cities studied, and with natural gas in all cities except Bismarck, Charleston, Columbia, Madison, and Seattle.

Solar manufacturers, architects, engineers, and builders will soon be able to use SOLCOST, the ERDA computer service recently established at Fort Collins, Colorado, to calculate the best size of solar hot water system, the most efficient tilt angle for collectors, and cost versus savings projections. To obtain this information, the user will have to fill out a four-page questionnaire and mail it to the SOLCOST service center. Results will be mailed back to the user. A handbook giving instructions on how to use SOLCOST can be obtained by writing to: SOLCOST, ERDA, Washington, D.C. 20545.

ERDA has selected Midwest Research Institute (MRI) to negotiate a contract for management and operation of the Solar Energy Research Institute (SERI) in support of the Nation's solar energy program. SERI, with an initial staff of up to 75 professionals, will be located at Golden, Colorado. As work at the site progresses, ERDA will offer planning grants to organizations selected to propose regionally-based solar research efforts. ERDA will ask MRI to help establish a solar regional network, which will include the North Central, New England, and Southeast regions.



CONCEPTUAL DRAWING OF FIVE MEGAWATT SOLAR THERMAL TEST FACILITY WHICH WILL BE CONSTRUCTED AT SANDIA LABORATORIES IN ALBUQUERQUE, NEW MEXICO

Wind Energy

Seventeen sites have been identified by ERDA as candidates, from which four final sites will be selected, for installation and testing of large experimental wind power electrical generating systems. Included are three candidate sites in the Missouri River Basin: the East River Power Cooperative at Huron, South Dakota; the City of Russell at Russell, Kansas; and the Central Nebraska Public Power and Irrigation District at Kingsley Dam, Nebraska. Wind monitoring instruments will be installed at each candidate site, and wind energy data will be collected. Test data from the three MRB sites will be used in combination with previously compiled data to select the four final test sites.

ERDA has selected two contractors to identify windy sites in New England and Hawaii for possible windmill locations and to assess the legal, social, environmental, economic, and technical considerations relating to installation development. The resulting studies should provide electric utilities throughout the country with background information useful in assessing the possibility of using wind energy conversion systems in their own regions. The two regional studies will be completed in one year.

The municipal utility in Clayton, New Mexico, a town of about 3,000 inhabitants, has been selected by ERDA to field test its 200-kilowatt (kw) wind turbine generator. The wind turbine--the term used for a modern electrical generating windmill--employs rotary motion to produce a maximum of 200 kw of regular alternating current power at the wind turbine's "rated wind speed" of 24 mph to 40 mph. When operating at the rated wind speed, the wind turbine produces enough power to meet the electrical needs of about 60 families. It will be tested for two years beginning in late 1977. In addition to operating the wind turbine, the Clayton utility will collect test data for ERDA.

ENERGY CONSERVATION

A program is underway in ERDA to increase the energy efficiency of present consumer products as well as to develop new energy-saving products for residential and commercial users. The program also supports research on technologies and materials that will aid the consumer in saving substantial amounts of energy.

Consumer Product Efficiency

Projects concerned with improving energy efficiency of consumer products include:

- Reinsulation of Water Heaters

A water heater refit kit, consisting of an insulation blanket, tape, and instructions, has been developed. It is estimated that reinsulation of water heaters nationally could save the equivalent of 30,000 barrels of oil a day by 1985.

- Dual-Purpose Household and Commercial Appliances

A new ERDA program designed to save energy and money by recycling waste heat from one appliance for use in another is currently underway. For example, exhaust heat from a refrigerator or air-conditioner could be used to keep the water hot in a water heater. The first phase, to be completed in mid-1977, requires that the study contractor compile a list of major appliances, their total energy use, time of use, and other information in order to determine which uses may be compatible. The project team will then develop designs and

production plans for a prototype unit that promises both a measurable reduction in energy consumption and an economic advantage to the user. Plans for a second phase call for one or more types of dual-purpose appliances to be built and tested by the end of 1978.

- A Model Energy Conservation Building Code

Four major building code organizations were brought together for the first time to develop a model code that could be incorporated into existing State and local codes for all new buildings. A preliminary version of the code, setting minimum energy-efficiency requirements for new building design and construction, heating, ventilating and air-conditioning systems, electrical systems, lighting, and water heating, has been completed. The technical standards upon which the code is based could reduce energy consumption by more than 11 percent in new single-family residences; nearly 60 percent in office buildings; nearly 43 percent in low-rise apartments; 40 percent in retail stores; and 48 percent in school buildings.

Energy Conservation Technologies

Projects concerned with development of new technologies for energy conservation include:

- Research on Heat Pumps

Heat pumps are devices that extract heat from a source, such as outside air, and discharge the heat into a building to warm it. In warm weather, the process can be reversed to discharge heat outside.

- Optical Window Insulation

ERDA has been developing a new type of window that can be added as a second pane to an existing window unit. Such a window would contain an optical shutter--a gel-like substance attached to the pane--and a heat mirror, consisting of a thin film imbedded in the glass. In summer when the sun's rays reach certain light and heat levels, the shutter would change automatically from a transparent state to a cloudy, white color that would reflect heat and light. In winter, the sun's rays would pass through the window, and heat would be prevented from bouncing back outside by the heat mirror.

- Microwave-Vacuum System: A New Grain Drying Technique

Because farmers burn more than a billion gallons of liquid propane and natural gas to dry each annual harvest, ERDA is working with the U.S. Department of Agriculture (USDA) to develop an alternative microwave-vacuum drying system to dry corn and other grain for storage without spoilage. The purpose of the project is to replace conventional grain drying techniques with systems that will run on electricity rather than directly burning scarce natural gas. In 1977, an experimental microwave-vacuum grain dryer will be built in Tifton, Georgia, for testing by USDA's Agricultural Research Service. ERDA expects these units to be commercially available by 1979.

- Waste Heat Recovery to Fuel Electricity Production

ERDA is developing a system that will use waste heat produced when fossil fuels are burned in large, stationary diesel electric engines to make heat for use in steel, glassmaking, or other industrial processes or to generate electricity. Instead of allowing waste heat to escape through exhaust stacks or into a body

of water, the system, called an organic Rankine cycle system (ORC), will capture the heat energy and divert it to a heat exchanger. In turn, the waste heat will vaporize a working fluid such as toluene, which has a lower boiling point than water. The resultant gaseous vapor then expands through a turbine and drives an electric generator. Development of the ORC system, including construction and field testing of five 600 kilowatt ORC units, will take place over a 4-year period.

- Development of Fuel Cell Electric Utility

ERDA is supporting development and construction of a utility-size fuel cell power plant module that will require two years to build and one year to test. In the electrochemical process that takes place in a fuel cell, the chemical energy that bonds atoms of hydrogen (from a hydrocarbon fuel such as coal, oil, or gas) and oxygen (from air) is converted directly to electrical energy. Because of their inherent efficiency, fuel cells can deliver up to 30 percent more electricity from a given amount of fuel than conventional generating systems. Furthermore, the operation is quiet, requires little maintenance, and emits water as a waste product. ERDA expects that the 4.8 megawatt (MW) fuel cell module demonstration plant will help expedite introduction of commercial size fuel cell generating plants by the early 1980's.

- Market Study for Lithium-Sulfur Battery

ERDA's Argonne National Laboratory has begun a study to identify possible future industrial and government customers for the lithium-sulfur battery developed by its scientists. This advanced battery is much more powerful than the conventional lead-acid batteries and could be used to charge electric vehicles by late 1978 or early 1979. It also promises to be an important energy and money-saving tool for electric utility companies. A large bank of thousands of advanced batteries could store excess electricity generated during low-demand periods. These could then be tied in during high-demand periods in place of "peaking" turbines fueled by natural gas or oil. Other potential customers include aerospace and mining industries and the military.

- Development of Two Electric Car Prototypes

Two new electric-powered vehicles will be built and tested by ERDA contractors over the next two years. The four-passenger vehicles will have an in-city driving range of 75 miles and will be capable of attaining cruising speeds of 55 miles per hour. One prototype will use a flywheel--which stores energy in the form of rapidly spinning motion--to store forward motion energy when brakes are applied, as well as to provide extra power for rapid acceleration and uphill driving. The second prototype will incorporate unique electronic controls for smooth and efficient performance. Costs to buy and operate these cars, when mass produced, would be competitive with conventional automobiles.

- Infrared Aerial Survey over Minnesota

As part of ERDA's program on energy conservation, an aerial reconnaissance study, conducted jointly by the Minnesota Energy Agency, the U.S. Environmental Protection Agency (EPA), and ERDA, is being carried out to detect heat loss from various buildings, pipe structures, and other objects on the ground and to identify potential insulation problems. This project consists of four phases: (I) an aerial survey by EPA aircraft equipped with a heat sensing scanner capable of detecting heat (infrared) radiation emanating from objects on the earth's surface; (II) processing and interpretation of infrared pictures by EPA personnel; (III) training community representatives to use this methodology; and (IV) preparation of an infrared picture interpretation manual to allow for recognition and diagnosis of infrared imagery.

Phases I and II were conducted between November 1976 and mid-March 1977 when 25 Minnesota cities were surveyed. The survey cities included Minneapolis, St. Paul, and Duluth. Phase III began in March 1977 with the first of three training seminars being held in St. Paul. Phase IV is in the process of being implemented. When the infrared interpretation manual becomes available, it will be distributed to other States and localities considering similar programs.

- Automated Climate Control System

ERDA has been involved in developing improved and lower cost automated energy management systems--devices which use computers to control heating, air conditioning, and lighting--in small to medium-sized buildings. Such equipment can also be used to provide early warning of the need for maintenance in heating or air-conditioning systems. In addition, ERDA has been developing devices that use heat, optical, or ultrasonic sensors to detect the presence of occupants in buildings. When occupants leave a room, the devices automatically turn off lights or turn down heating or air conditioning.

ENVIRONMENT AND SAFETY

Land Reclamation

ERDA has undertaken a comprehensive program of applied and basic research on the physical and ecological problems of land reclamation. In carrying out this program, ERDA is coordinating its research efforts and cooperating in many specific projects with other Federal agencies (primarily the Departments of the Interior and Agriculture and the U.S. Environmental Protection Agency); State agencies and State-sponsored organizations, regional organizations; and representatives of the coal industry. As part of this program, field study projects are underway in one or more mines in four of America's major coal producing regions: the Northern Great Plains, the Rocky Mountain States, the Southwest, and the Central Interior. Project descriptions are as follows:

- Northern Great Plains

Big Horn Mine, Sheridan, Wyoming

One of the primary goals of research at the site is to assess the impacts of mining and reclamation practices on water quality (both surface and ground water) and water availability in the western region. Impacts of mining on aquatic life and soil micro-organisms will also be studied.

Indian Head Mine, Zap, North Dakota

North Dakota reclamation laws require segregation and storage of the stripped topsoil, which is later spread over graded spoil and used for revegetation. Two aspects of this reclamation practice, which is common to a number of States, are being explored: the ability of plant roots to penetrate the topsoil/spoil mixture, and the effects of segregated storage on micro-organisms in the topsoil.

- Rocky Mountain States

Jim Bridger Mine, near Rock Springs, Wyoming

Field research at the mine is aimed at identifying principles of adaptation and survival of native Wyoming plant species under stressed

conditions of reclamation; evaluating effects of changes in soil composition upon water availability; and analyzing effects of reclamation techniques on plant and animal communities and soil micro-organisms.

RECLAMATION OF STRIP MINED LAND AFTER GRADING IS COMPLETED

- Southwest United States

Researchers are evaluating methods of "water harvesting"--capturing water runoff from strip-mine spoils--and using the runoff to increase range and crop plant production. Other scientists are studying effects of surface mining on soil micro-organisms, and are attempting to identify or develop plant species especially adapted for use in reclaiming southwestern lands.

- Central Interior United States

Production of acid runoff during strip mining and the movement of acids into local ponds and ground water are being investigated at abandoned strip mines. Areas of abandoned refuse from underground mining are the site of a comprehensive reclamation project funded jointly by ERDA and the State of Illinois. The extent of environmental degradation due to the refuse area is being determined, and methods for reclaiming land with this kind of problem are being developed, tested, and evaluated.

In addition to the above research, which is being coordinated by ERDA's Argonne National Laboratory, ERDA's Division of Biomedical and Environmental Research is supporting the following related studies:

- A study of the process of natural revegetation on "orphan" or abandoned strip-mined spoils in Missouri (University of Missouri);

- An investigation of the manner in which native plant species reestablish themselves on surface-mined land in Montana (Montana State University);

- Experiments to determine the proper time and way in which to collect, handle, and replant seeds of native grasses, plants, and shrubs for revegetating surface-mined land in Montana (University of Montana);

- A study of varied environmental aspects of coal production in Appalachia (University of Tennessee); and

- A study of special irrigation methods that could be used to restore strip-mined lands in an arid region of Washington (Battelle Northwest Laboratory).

Survey of Mine Effluent Control Technologies in Eastern-Midwestern Coal Region

A joint survey by ERDA and the U.S. Environmental Protection Agency is currently underway at 22 strip-mining sites to evaluate pollution control technologies for mine effluents. These sites are located in 17 States east of the 100th meridian (the point that separates the low-sulfur coal of the Western-Midwestern region from the high-sulfur coal of the Eastern-Midwestern region).

Coal production in the high-sulfur region is expected to increase significantly during the next quarter century. Coupled with the estimate of future coal production levels, this evaluation will provide the basis for identifying present control technologies that may be adequate for new mines and will suggest alternative systems that may be used in existing and expanding mines. The study began in late 1975 and will be completed by the end of fiscal 1977.

Revegetation Potential of Future Oil Shale Waste Land

ERDA is sponsoring two related research efforts to find ways to minimize environmental problems that may result from future oil shale development. The first study will try to grow an assortment of grasses, shrubs, and other plants in special "rock gardens" that will permit a determination of the amount and kinds of trace elements absorbed from the oil shale wastes by the plants. These studies are being coordinated with related research being sponsored by the Departments of Interior and Agriculture.

Manned Balloon Tracking of Urban Air Pollutant Transport

As a major part of Project DaVinci, ERDA has used a manned helium-filled balloon to follow industrial and urban air pollution into the surrounding countryside and to measure and record the chemical and physical changes that take place in the "plume" of pollutants. Preliminary findings indicate that high levels of ozone and sulfur dioxide did not dissipate but persisted during the flights. Project DaVinci is a joint effort between ERDA, the National Oceanic and Atmospheric Administration, and the U.S. Environmental Protection Agency. All flight operations and much of the data collection and analysis are the responsibility of ERDA's Scandia Laboratories in Albuquerque, New Mexico.

ERDA's Network of National Environmental Research Parks

Four large ERDA-owned sites have been designated as National Environmental Research Parks (NERP). Each site represents a different type of environment, and contains a wide variety of plants, wildlife, and geological formations. The first NERP was established at ERDA's Savannah River Plant in 1972, followed by ERDA's Idaho National Engineering Laboratory (1975), ERDA's Hanford Reserve in central Washington State (1976), and ERDA's Los Alamos Scientific Laboratory (1976). All of the protected outdoor laboratories are available to scientists throughout the country for a wide variety of ERDA and non-ERDA environmental research programs. A major advantage of providing the sites is that long-term ecological studies requiring controlled lands and in-situ instrumentation can be conducted undisturbed. Other potential NERP sites presently being considered by ERDA are the Oak Ridge (Tennessee) Reservation; the Nevada Test Site; the Brookhaven Reserve on Long Island (New York); and, in cooperation with the U.S. Forest Service, a research area in the Loquillo National Forest of Puerto Rico.

CHAPTER 5: ENVIRONMENTAL ISSUES RELATED TO POWER PRODUCTION AND ENERGY DEVELOPMENT

The national commitment to achieve independence or near independence in the area of energy resources has resulted in intensive program efforts to identify, quantify, and develop the energy resource potentials of the Nation. In regard to new energy development initiatives, the middle and upper segments of the Missouri River Basin are receiving considerable attention due to the presence of extensive deposits of low sulfur coal.

In addition to coal, the Missouri River Basin contains economically recoverable quantities of natural gas, petroleum, and uranium. Development of solar and wind resource potentials in the basin could have significance as nonpolluting energy sources in the future. Although the potential for additional hydroelectric power development is somewhat limited, the water resources of the Missouri River Basin will play a crucial role in development of the basin's other energy resources, particularly coal.

Intensive efforts to develop the energy resource potentials of the basin, particularly those in the northern Great Plains, have generated considerable controversy regarding the possible environmental and social consequences of such developments. The nature of the social and environmental concerns are diverse. They include the possible adverse effects of development on the social structure of local communities, crime rates, adequacy and costs associated with waste water treatment facilities, school systems, air quality deterioration, water depletion, decrease in agricultural production capabilities, effectiveness of reclamation measures, postdevelopment economies, and ecological values. In response to these concerns, numerous studies have been initiated by industry, universities, the scientific community, and government to more clearly define the impacts that can be anticipated from an accelerated level of energy development activity.

COAL

Mining and Extraction

- Air Quality

The existing atmospheric pollution problems associated with coal resource development in the Missouri River Basin are expected to increase in severity with future increases in coal production. The primary air quality impact of coal mining operations is the potential for an increase in suspended particulates, to include fugitive dust emissions. Ambient concentrations of air pollutants can be expected to increase on at least a localized basis, particularly in areas where there is a collective aggregation of coal mines, coal conversion, and coal combustion facilities.

Current studies are being directed at determining particulate emissions from coal mines in an effort to obtain more accurate estimates of coal mining impacts. Models and other analytical techniques are also being utilized to project various air impacts of particulate additions. Emission control technologies for coal mining and coal conversion operations are being developed and improved because some of the current technology offers only crude control opportunities.

• Water Quality

The surface mining and extraction of energy resources, principally subbituminous coal and lignite, in the Missouri River Basin has the potential for adversely affecting the quality of the waters of the basin. Some of the more significant potential impacts include the deterioration of surface water quality due to increased sediment loads, channel modifications, coal mine leachate, and the disturbance and contamination of shallow ground water systems, including multiaquifer interconnection and aquifer disruption.

The magnitude and duration of such environmental impacts is primarily a function of the mining and reclamation practices undertaken by the operator and the extent of environmental conditions. Practices that might be implemented by the operator as mitigating measures include premining planning; selection of surface mining methods and coal extraction and preparation practices which maximize stabilization and minimize soil erosion; utilization of mined land reclamation methods which include selective spoil placement, runoff interception and diversion, topsoiling, grading and revegetation; and water quality monitoring.

Current studies relating to the environmental effects of surface mining and extraction of energy resources in the Missouri River Basin have been oriented toward the determination of baseline environmental conditions in future development areas, the evaluation of environmental impacts resulting from existing mining operations, and the utilization of models or other analytical techniques to project water impacts and reclamation potential. Such studies are currently being undertaken by the Environmental Protection Agency, U.S. Geological Survey, Bureau of Land Management, Bureau of Reclamation, Bureau of Mines, Agricultural Research Service, U.S. Forest Service, numerous State agencies, the Old West Regional Commission, and others.

Coal Conversion/Combustion

• Air Quality

Stack emissions of concern from process and electric steam generators consist of particulates, sulfur dioxide, and nitrogen oxides. These pollutants can be limited or controlled by modifying the process itself, utilizing a fuel or feedstock which will not produce as much pollutant, or removing a significant amount of the pollutant from the stock gases. However, the massive quantity of pollutants that can be generated by just one facility, even when heavily controlled, can create environmental or esthetic damage. A number of facilities that all contribute their share of pollutants to the atmosphere will gradually increase the impact of those pollutants on the environment until no more can be tolerated, especially in a small area. Resource availability often dictates the location of such facilities and the competition for space to develop is keen.

While control technology is being improved and can be very effective when implemented to limit emissions, the regulations that govern coal combustion facility activities are also being refined. New stationary sources, in particular, may find in the future that emission limits for all pollutants will be stricter and that allowable ambient concentrations will be lower. Several large portions of the Missouri River Basin are now specified for the prevention of significant degradation (PSD), and certain specified incremental levels are

presently in effect for suspended particulates and sulfur dioxide. Under PSD regulations, certain governmental entities and jurisdictions (i.e. Indian tribes, county governments) have the power to select the level of increments (i.e. from very small to allowing degradation up to national air quality standards) that they desire. The Northern Cheyenne Indian Reservation has been designated a Class I area by the Tribe. Since pollution ignores political boundaries, the siting of various stationary facilities will be critical to ensure that assigned portions of the PSD increment are not exceeded or over-used.

The Clean Air Act Amendments of 1977 (Public Law 95-95), enacted August 7, 1977, made certain immediate changes to the Environmental Protection Agency's regulations concerning the prevention of significant deterioration of air quality. These regulations establish a scheme for protecting areas with air quality cleaner than minimum national standards. Section 162(a) of the Act automatically classified all international parks, all national wilderness areas which exceed 5,000 acres in size, all national memorial parks which exceed 5,000 acres in size, and all national parks which exceed 6,000 acres in size as Class I areas. This designation applies only to areas which were in existence on the date of enactment of the new amendments. The Federal Register, (Volume 42, No. 212, dated Thursday, November 3, 1977) identified those Federal lands which are mandatory Class I areas. Following is a list of mandatory Class I areas within the Missouri River Basin with total acreage shown for each area, some portion of which may be outside of the basin.

National Parks over 6,000 acres	Total Acres
Colorado - Rocky Mountain	263,138
Montana - Glacier	1,012,599
South Dakota - Wind Cave	28,060
Wyoming - Yellowstone	2,219,737
National Wilderness Areas over 5,000 acres	
Colorado - Rawah	26,674
Montana - Bob Marshall	950,000
- Gates of the Mountain	28,562
- Medicine Lake	11,366
- Scapegoat	239,295
North Dakota - Lostwood	5,577
South Dakota - Badlands	64,250
Wyoming - Fitzpatrick	191,103
- North Absaroka	351,104
- Teton	557,311
- Washakie	686,584
National Memorial Parks	
North Dakota - Theodore Roosevelt National Memorial Park	69,675

Trace metals contained in the raw coal, which are emitted as atmospheric pollutants upon combustion, continue to be studied for their effect and for the development of possible control technologies.

- Water Quality

Coal conversion includes combustion, gasification, and liquefaction and can result in environmental impacts to the water, air, and land. The quantity and quality of water effluents, air emissions, solid wastes, and associated land impacts are dependent upon considerations such as the type of process, type of intermediate and end products, pollution control measures, and site-specific factors, among others.

Since no commercial size conversion facilities exist today in the United States, present quantification and qualification of wastes from such facilities are generally based upon extrapolations from laboratory experiments, bench scale tests, and limited pilot plant operations. Some waste and residue information has, however, been gained from commercial size operations outside the United States.

On an individual basis, the surface water quality impact of coal conversion in the Missouri River Basin may be low if facilities continue to pursue a no-surface discharge policy. Surface water impacts could result, however, due to cumulative impacts of depletion resulting from construction and operation of several coal conversion facilities. Cumulative impacts stemming from water depletion may be offset somewhat by practicing water use minimization. Minimization can be achieved through reuse and conservation in cooling, process requirements, and general housekeeping, but to achieve such requires careful consideration in both planning and design. In those instances where cooling water is discharged, thermal problems could result. Reduction or control in those instances may be achieved through combined wet/dry or all dry cooling.

Ground water may be significantly impacted unless adequate facility planning and maintenance of total retention facilities, proposed deep well injection systems, dewatering of in-situ operations, and backflood water controls are followed. Design, construction, and maintenance of total retention facilities must ensure that contaminated wastewater is totally contained and that proposed deep well injection systems will not introduce wastewater into presently utilized or future source aquifers. Dewatering could, depending upon quality, result in potential surface water problems associated with disposal. Backflood waters could have a major impact on the ground water system due to water quality changes. The quality of backflood waters will have to be characterized, and plans will have to be developed to prevent such backflooding or to improve the quality of the backflood waters.

Solid wastes associated with coal conversion include process waste residues and nonmarketable byproducts, spent catalysts if not regenerable, solid wastes from pollution control processes and influent water treatment, and ancillary facility wastes such as sewage sludge and waste products from construction and maintenance. Adverse environmental impacts in areas such as landfill stability, leachate formation and movement, and reclamation can result if proper solid waste techniques are not planned and pursued.

Although not a direct environmental impact, the competitive use of water between conversion and agriculture, and decisions relating to that use, could impact water quality and availability. Questions and issues relating to multiple use and reuse as well as competitive uses must be considered.

Transportation, Transmission, and Support Facilities

Transportation of coal resources will pose some fugitive particulate emission problems along the route selected. The frequency of the trips, season, and control techniques employed will all determine the magnitude of the problem. As the coal industry grows, the transportation system will expand to handle the increased volume of coal produced.

Support facilities include the construction and maintenance of an energy facility but, possibly more important over the long term, are the existing and new communities that will house and supply the personnel required to support these facilities. Many factors about "boom" growth and the resultant effect on the environment remain unknown, but the visual and measured effects on the air quality in high growth communities associated with energy development have been documented. Intelligent planning and proper guidance of growth in the affected communities will be necessary in order to avoid or minimize the impacts caused by an influx of many people.

Whether talking about raw coal or the products of conversion such as gas, oil, or electrical energy, the resource or product must be delivered to the user. Coal, as a raw resource, can be transported by truck, rail, barge, or slurry pipeline.

Potential environmental impacts to surface and ground waters that are common to all transportation modes include runoff from storage and load-out facilities and from accidental spills. Runoff from haul roads and rail rights-of-way, where natural materials and chemicals used for dust control and weed control can be transported, have potential impacts for water quality. If black water from slurry pipelines is not properly reused, contained, or treated and released, impacts to water quality can result. Water supply reductions and competitive water use for slurry pipelines can also impact water quality through depletion, particularly in the semiarid Western United States.

Coal transportation, particularly by truck and rail, can also produce significant problems associated with community traffic flow disruption and noise. As coal transportation increases, the potential for disruption also increases and could become quite a significant problem.

Coal conversion products of gas and oil can be transported by truck, rail, barge, or pipeline. Potential impacts from transporting by such modes are similar to transporting coal in the same manner. If pipelines are properly constructed and maintained, water impacts can be minimized. Accidental spills, however, can have a significant impact on water quality.

Transmission of electrical power can impact water quality through runoff from improperly maintained transmission rights-of-way. The potential does exist for health and nuisance effects from high voltage lines, but such impacts can be minimized by careful route and structure planning.

Land Use and Reclamation

Perhaps second only to regional concerns over social, cultural, and economic changes brought about by large-scale industrialization, principally related to the extraction and the use of energy fuels, is a concern for the reclamation of lands containing shallow deposits of coal and uranium that have

been or will be mined by surface extraction methods. The reclaiming of mined or orphaned land cannot be overemphasized because it is critical to assuring that surface mining represents only a temporary use of the land. In the case of surface-mined coal, it is entirely reasonable to assume that mining is a temporary imposition on other land uses.

SURFACE EXTRACTION - PACIFIC POWER AND LIGHT STRIP MINE GLENROCK, WYOMING

In view of the wealth of experience gained in revegetating agricultural lands and lands disturbed during highway construction and urban building, it is useful to question the differences, if any, between agricultural or highway reclamation and reclamation of mined lands. Generally, a significant difference is the thickness (or depth) of earth materials disturbed during surface mining, and the fact that, in many cases, materials lying over the coal (or overburden) are by their geologic nature inherently saline (by virtue of high sodium content in addition to other minerals). Obviously, such high sodic materials, unless properly placed, will have deleterious effects on subsequent agricultural activities.

Inhabitants of the Upper Missouri River Basin are only too familiar with the problems of wind and water erosion of lands from which vegetation has been removed. Similarly, surface mined lands will be subject to such erosive forces until such time as a protective vegetative cover is established. Basin residents are also aware of the difficulties of attempting to reintroduce native vegetative systems to disturbed lands. Other challenges encountered when reclaiming mined lands involve slope and aspect of graded lands. Although there is certainly promise for success in select areas, many years will be required to determine whether revegetation efforts on surface mined lands will truly be successful in terms of plant stability, succession, and productivity.

There has been proper concern over the relative importance of land disturbance caused by surface mining. Actually, those lands with deposits of coal at least 5 feet (1.5 meters) thick and lying less than 200 feet (60 meters) below the surface, which may presently be considered economically recoverable, occupy a very small percentage of the total area of the Missouri River Basin. However, overburden above such coals is often thinnest in valleys and the lower plains. Therefore, it is most economical to mine those coals. These same valleys and plains are often the mainstays of the agricultural operations--operations which in turn form the economic backbone of the basin and which will continue to persist over the longer term. Thus, the lands that may be disturbed by surface mining of coal tend to include, in a number of cases, lands currently used for more intensive agriculture--as opposed to lands in the areas of higher elevation with rocky outcrops and lower agricultural productivities. Surface mine land reclamation has not demonstrated, to date, that the essential agricultural and hydrologic functions of such valley areas can always be reestablished.

PETROLEUM AND NATURAL GAS

The four major phases of the petroleum and natural gas industry are exploration, production, transportation, and processing. Each phase of the industry has varying environmental impacts in various ranges of magnitude. The exploration phase will cause only minor environmental impact in the form of land disturbance to create access roads and drilling areas, solid waste disposal in the form of drill cuttings, potential dust generation from land clearing, and brine seepage from holding ponds.

Environmental impacts resulting from the production of oil are somewhat related to the type of recovery (primary, secondary, and tertiary) being practiced. The advanced recovery techniques require more energy inputs and more water resulting in increased air emissions and more water pollutants. The primary air pollutants of concern are hydrocarbons and carbon monoxide from evaporation sources and H_2S and SO_2 from flaring. Oil and grease, salts, and total dissolved solids must be considered when discussing environmental impacts from water reinjection or discharge.

The transportation phase of the industry places stress upon the environment in the form of land disturbance during pipeline construction and in the form of oil spills during the operation of the pipeline. Oil spills can cause, depending on location, environmental degradation of land and water.

Section 311 of the Federal Water Pollution Control Act of 1972 (P.L. 92-500) has declared that it is the policy of the United States that there should be no discharges of oil into navigable waters. The EPA has been delegated the authority to remove oil spills in water if the owner or operator of the vessel or facility causing the discharge is not performing proper removal. The

U.S. Coast Guard has been given the responsibility to administer the Federal Pollution Fund. It is this fund that receives civil penalties assessed for oil spills and provides monies for Federal cleanup actions.

Effects of oil in water have been dramatically displayed in numerous recent spills. Most visible is the coating effect oil has on almost anything it contacts--wildlife, waterfowl, vegetation, and fish. The oil film acts as a barrier to normal fluid and air interchange between any organism and its supporting environment. Distress, and in most instances death, will befall the affected organism. There were no major (greater than 10,000 gallons) oil spills recorded in the Missouri River Basin in 1976.

Oil spills can be grouped into two main categories to aid in identification: transportation-related and nontransportation-related. Transportationrelated spills occur from accidents when the oil is being moved by pipeline, railroad, truck, or boat. Energy development will require the transporting of fuel to the work site. The required increase in shipment will increase the probability for a spill from a transportation-related source.

Nontransportation-related spills occur from fixed storage vessels, refineries, and production fields. It is not anticipated that new refineries will be built in this area, and there are no significant producing fields downstream from Williston, North Dakota. However, there will be an increase in bulk oil storage at the energy development sites. There would be an expected increase in the chance for spillage from this type of storage if the Oil Pollution Prevention Regulation, 40 CFR 112, did not apply to these facilities. A Spill Prevention Control and Countermeasure (SPCC) Plan, developed by the owner or operator to comply with the regulation, should preclude any spills from reaching a waterway.

The processing phase of the industry has probably the greatest environmental impact. Refining of the crude oil into marketable products requires water use, generates air emissions, and produces solids to be eliminated. Environmental control regulations in the form of water effluent guidelines and new source performance standards for air quality are being promulgated to minimize the environmental impact of new or modified refineries.

NUCLEAR FUELS PROCESSING AND POWER GENERATION

Due to the limited number of nuclear facilities in the Missouri River Basin, the possibility of a nuclear catastrophe associated with these plants is somewhat remote. Concerns over possible radioactive contaminants being emitted from such facilities has prompted a general increase in monitoring of nuclear facilities, as well as increased protection against sabotage and theft.

Potential radioactivity problems are not only restricted to plant operations. In Wyoming, a State that contains 35 percent of the total U.S. uranium reserves, extensive uranium resource development could greatly increase the potential for radioactive contamination. Due to possible impacts on surface and ground water resources, uranium mining and milling must be carefully monitored.

Additional problems relate to the presence of radon gas, the infiltration of radium into ground waters, and reclamation of mined areas.

Solar Energy

In examining the environmental impacts of the solar resource, it is advantageous to divide solar technology applications into two categories, those being, local or individual technologies, (e.g., solar home heating, crop drying, greenhouses) and community (or regional) technologies, (e.g., solar power plants). The indication has been that solar energy is one source of energy that will not degrade the environment. Such a statement may very well be true when the solar resource is compared to conventional energy sources such as coal. Solar energy, however, does exhibit some subtle environmental impacts. For example, the question of esthetic impact arises with respect to local technologies. The design of solar heated buildings is significantly different from that of conventional buildings. This is necessary in order to maximize collection and use of the solar energy that strikes the collector surface.

Regarding community technologies, it is essential to make the most beneficial and appropriate use of lands. This is particularly relevant since a 1,000 MW commercial solar power plant, such as is now envisioned, would require 3,000 to 6,000 acres (4.7 to 9.4 square miles) of land.

The Solar Energy Research Institute, to be located in Golden, Colorado, will examine these impacts.

Wind Energy

Much of the region encompassed by the Missouri River Basin provides great promise as an area within which large-scale wind energy development may occur. Sites such as Great Falls, Montana, and Casper, Wyoming, record average wind speeds in excess of 13 miles per hour. The environmental impacts associated with wind energy development appear to be relatively insignificant. Where there are clusters of wind turbines, there is the possibility of localized weather disturbances but perhaps no more so than that which is prevalent around tall buildings. There is also the possibility of noise pollution resulting from the revolving blades and the undesirable esthetic impact of turbine towers cluttering the landscape.

Geothermal Energy

Although large-scale geothermal resource development seems relatively remote within the Missouri River Basin, both "Known Geothermal Resource Areas" and "Lands Valuable Prospectively for Geothermal Resources," as defined by U.S. Geological Survey, do exist in basin States. The geothermal resource exhibits a greater and more diverse number of environmental impacts than those associated with other alternative energy sources. Air emissions that contain pollutants, such as particulates, SO_X, NO_X, CO, and H_2S, are of critical importance. Degradation of surface and ground waters may also occur unless the geothermal effluent is disposed of properly. Proper disposal involves injection of the effluent into the geothermal zone. This would be done not only to reduce deterioration of potable water sources but also to prevent subsidence due to aquifer mining. Injection must also be performed to ensure that seismic activity is not induced along fault zones.

Monitoring systems for geothermal fields are being developed by EPA's Environmental Monitoring and Support Laboratory in Las Vegas, Nevada.

Biomass

Biomass energy is produced as a result of the use of organic material, either directly or through chemical conversion, as a fuel. Sources of biomass are fast growing trees or other vegetative types that may be burned directly, animal wastes that are converted to methane, and starch grains that are converted to alcohol which is then combined with gasoline. Environmental impacts associated with energy production from biomass include air emissions from conversion facilities and disposal of wastes from completed processes. Again, the land use question of whether it is better to use agriculturally productive lands to grow fuel or food arises.

Solid Waste

The use of solid waste (garbage or trash) represents yet another source of energy. However, since the number of large metropolitan areas within the Missouri River Basin is small when compared to other regions of the country, the use of solid waste as a supplemental fuel may not be practical until some time in the future. The Denver Council of Governments, in a study partially funded by the Environmental Protection Agency, has found that a resource recovery plant that would convert solid waste to fuel pellets is not feasible at this time.

Environmental impacts prevalent when solid waste is converted to fuel include air emissions, particularly if exotic elements used in packaging are emitted. Further, there is still the necessity to dispose of ash or waste following the conversion process.

SOCIOECONOMIC-CULTURAL-ESTHETIC IMPACTS

The major socioeconomic impacts related to semi-intensive and concentrated energy development activities in the Middle and Upper portions of the Missouri River Basin are (1) in-migration to meet increased employment demands during construction and operation phases of development; (2) the resultant demand for housing and human and municipal services, coupled with community problems associated with obtaining or generating front end monies to provide traditional community services; (3) the impacts on the local and regional economy of new and increased employment opportunities at higher wage scales, new revenues produced by energy activities, and changes in the structure of the economy as a result of shifts in the relative importance of the basic economic sectors; and (4) impacts associated with the postdevelopment period.

A major portion of those communities that have been or will be impacted by energy development are small rural communities. Residents place a high value on a rural life style that has evolved over a period of several decades, with particular importance placed on those values that distinguish small rural communities from urban areas.

A primary concern expressed by members of the rural community is the potential for their respective communities to become "boom towns" with the local residents having limited control over many aspects of growth-related problems. The need for planning to mitigate anticipated impacts is well understood. The primary problem is one of the community obtaining, in a timely fashion, the answers to when, where, and how many people will be associated with a particular development initiative or mix of developments.

Visual impacts associated with various types of development could inflict significant change on relatively unscathed landscapes. In addition to community-

related considerations, projected visual impacts would include those associated with road and facility construction, storage facilities, mining, processing operations, air quality impacts, water quality impacts, and general deterioration of environmental quality. The magnitude of eventual impact is, of course, very much a function of the adequacy of the environmental controls and mitigation measures planned prior to development.

The added demands on the recreation resource base caused by increased population levels could contribute significantly to environmental degradation if a wide disparity between supply and demand exists. A main concern is the overuse and exploitation of existing resources because funding priorities for recreation facilities and opportunities are often based on existing population levels rather than projected levels of demand.

To some extent, there is concern among local residents that newcomers to their community might not have the same appreciation for protection of the natural resource base. Problems associated with poaching of game animals and law enforcement are some of the concerns expressed by predevelopment residents.

GENERAL ENVIRONMENTAL REGULATIONS

Federal environmental regulations that pertain to most aspects of energy production have been promulgated and are enforced by both the Department of the Interior and the Environmental Protection Agency. These regulations have direct implications for fuel mining and processing areas, as well as for generating facilities.

Environmental Protection Agency

The Environmental Protection Agency is responsible for administering four major water quality regulatory programs related to energy development and electric power production.

- Coal Mining Point Source Effluent Guidelines. These regulations establish maximum discharge concentrations for hydrogen ion concentrations (pH), iron (Fe), manganese (Mn), and total suspended solids (Tss) for coal mine point source discharges. Final rules for existing sources became fully effective on July 1, 1977 (40 CFR 434).

- Ore Mining and Processing Point Source Effluent Guidelines. These regulations established maximum allowable discharge limitations for cadmium (Cd), zinc (Zn), arsenic (As), radium 226 (Ra 226), uranium (U), chemical oxygen demand (COD), Tss, and pH for uranium mines and mill point source discharges. The regulations were suspended on May 24, 1976.

- Underground Waste Injection Control Program. Under regulations covering the Safe Drinking Water Act (P.L. 93-523), States are encouraged to establish programs that require issuance of a permit for the underground injection of all wastes and that prohibit injections under circumstances that would endanger drinking water sources. At present, Nebraska, Minnesota, and Iowa are the only basin States that have affectively established underground waste injection control programs.

- Thermal Effluent Limitations. Section 316 of the Federal Water Pollution Control Act required EPA to develop guidelines for the control of thermal discharges. As a result, effluent guidelines and standards were developed and published for steam-electric power generating point sources in 1974. In response to legal challenges, the existing guidelines were remanded by court order in July 1976. EPA is presently in the process of revising and modifying the guidelines to comply with the court finding, and new thermal effluent rules are anticipated to be issued in late 1978.

Department of the Interior

The U.S. Department of the Interior administers three major coal resource regulatory programs. The three include the new Federal Surface Coal Mining Law, a series of coal mining operating regulations, and the Energy Minerals Activity Recommendation System (EMARS) leasing program.

• EMARS Leasing Process. This activity implements a Federal program to develop comprehensive land use plans (known as Management Framework Plans) that identify other resources in known coal leasing areas, resolve use conflicts, and prioritize sites for coal leasing. In addition, the program receives and rescinds nominations for perspective coal lease tracts leading ultimately to competitive lease sales (operated by the Bureau of Land Management). The EMARS leasing process is complemented by the Mineral Leasing Act Amendments of 1975. BLM has, at present, suspended all major coal lease sales because of a lawsuit challenging the Coal Programmatic Environmental Statement portion of the EMARS process. Pending a final decision on the suit presently before the Federal courts, the department continues to lease small amounts of coal on a short-term basis to maintain current levels of production. As a result of the legal challenge, it is anticipated that no major coal leases will be negotiated for a period of from one to three years.

• Coal Mining Operating Regulations (30 CFR 211 and 43 CFR 3041). These regulations provide detailed environmental protection standards and information requirements for the mining of Federal coals.

• Surface Mining Control and Reclamation Act of 1977. The Strip Mining Control Bill (Public Law 95-87), signed into law on October 3, 1977, creates an Office of Surface Mining Reclamation and Enforcement within the Department of the Interior. Specific duties of the Office under the law, which establishes minimum environmental protection standards for the mining of all coals, include administering the Act's regulatory and reclamation programs, providing grants and technical assistance to the States, and approving and disapproving State programs. The Act also includes provisions that specify inspection and enforcement requirements, that create an abandoned mine reclamation fund, and that provide for surface owner protection. The Act is designed to place emphasis on State administration of the program.

In addition to its three major regulatory programs, the Department of the Interior requires the preparation of environmental impact statements by utilities filing powerplant applications. On July 25, 1977, the Interior Department announced the availability of a new contract-prepared report entitled "Guidelines for the Preparation of Environmental Reports for Fossil-Fueled Steam-Electric Generating Stations." The report is intended to be used in developing future departmental guidelines for environmental information required from powerplant permit applicants.

ENVIRONMENTAL CONTROL COSTS

Efforts to control air emissions and water effluents from power generating plants have resulted in the strict establishment and enforcement of environmental regulations. The compliance costs resulting from the installation of pollution abatement equipment necessary to meet regulation standards have been quite high, and the technology required to solve the associated environmental problems is still developing. Major emission control concerns are presently directed at air releases and water discharges.

Air Emission Control Facilities and Installation Costs

The primary equipment costs associated with air emissions from electric power plants relates to controlling the release of particulate and gaseous matter into the atmosphere. The problem of particulate emissions from stacks of coal and lignite-fueled electric plants is largely being solved by the installation of mechanical separators and electrostatic precipitators. Depending on size and type, mechanical collectors can remove 65 to 94 percent of the particulates present in flue gas, and electrostatic precipitators can operate at particulate removal efficiencies of between 92 and 99 percent.

Gaseous emissions, largely in the form of sulfur oxides, pose a considerably greater problem. Various systems that are designed to remove a portion of this emission are now undergoing prototype testing. However, none of these systems have operated for extended periods on large baseload units. It is generally agreed that sulfur dioxide stack gas removal (desulfurization) systems, when perfected and installed, will result in a significant increase in the cost of constructing a coal or lignite-fueled electric plant.

Table 20 provides typical projected 1976-1981 cost figures for the installation of particulate and gaseous emission control equipment at Missouri River Basin plants.

TABLE 20

TYPICAL COSTS REPORTED IN FPC FORM 67 FOR AIR QUALITY CONTROL EQUIPMENT ON NEW GENERATING UNITS

Plant Name	Operator	Scheduled In-Service (year)	Particulate Removal ($/kW)	Stack Gas Removal ($/kW)
Gentleman #1	Nebraska Public Power District	1978	12.78	--
Sherburne 1 & 2 2/	Northern States Power	1976-1977	1/	41.67
Nebraska City	Omaha Public Power District	1979	12.57	--
Coyote #1	Montana-Dakota Util.	1981	44.00	114.00
Coal Creek #1	Cooperative Power Assn.	1978	25.97	20.49
Duck Creek #1 2/	Central Ill. Light Co.	1976	29.47	93.32
Neil Simpson	Black Hills P & L	1977	101.98	--
Ottumwa 2/	Iowa Southern Util.	1981	44.80	--
Neal #4	Iowa Public Service	1979	80.34	--

Source: Data based on 11/1/76 report of Part IV to FPC Form 67.
1/ Particulate Removal included with Stack Gas Removal System.
2/ Not located in Missouri Basin.

According to Harza Energy Model projections developed for MRBC's Yellowstone Level B Study, current installed construction costs for sulfur removal scrubbers at coal-fired generating plants are estimated at $70,200 per megawatt ($70.20 per kilowatt) of installed service capacity. Estimated level B costs for other remedial options for high sulfur coal average $3,500/MW ($3.50/kw) and $2,600 MW ($2.60/kw), respectively, for plant site blending and mine-mouth blending.

Water Quality Control Costs

Major water quality control expenditures associated with electric generating plants primarily relate to the cost of constructing and operating different types of thermal cooling systems. The costs for alternative cooling systems are usually expressed in terms of either total cost, annual cost ($/year), production costs (mills/kilowatt hour), or investment costs ($/kilowatt). Table 21 provides a comparison of typical investment costs by alternative cooling systems for 600 MW and larger fossil-fueled and nuclear steam-electric plants.

As a point of comparison, a second set of cooling system cost computations, prepared for use in development of the Harza Energy Model, are available from the MRBC-led Yellowstone Level B Study. For the level B study, current construction costs for different baseload cooling systems were estimated at $3.50/kW for cooling ponds, $6.40/kW for spray ponds, $8.50/kW for natural draft wet towers, $4.00/kW for mechanical draft wet towers, $34.00/kW for mechanical draft dry towers.

TABLE 21

COSTS OF COOLING SYSTEMS FOR STEAM-ELECTRIC PLANTS

Type of System	Investment Costs ($/kW) Fossil Plant	Nuclear Plant
Once-Through[1/]	2.00 - 3.00	3.00 - 5.00
Cooling Ponds[2/]	4.00 - 6.00	6.00 - 9.00
Wet Cooling Towers		
Mechanical Draft	5.00 - 8.00	8.00 - 11.00
Natural Draft	6.00 - 9.00	9.00 - 13.00
Dry Cooling Towers		
Mechanical Draft	18.00 - 20.00	26.00 - 28.00
Natural Draft	20.00 - 24.00	28.00 - 32.00

Source: CEQ, Energy Alternatives, 1975, Chapter 12.
1/ Direct circulation involving no pond or reservoir investment.
2/ Cost data for artificial ponds capable of handling 1,200 to 2,000 MW of generating capacity.

Further, cost figures for cooling water systems in the Northern Great Plains area tend to vary somewhat from national averages because of meteorological conditions and water availability and costs. Based on a 1974 Northern Great Plains Resources Program (NGPRP) Study, EPA reported the cooling device capital costs (in $/kW) and the total cooling system costs (in Mills/KWH) for wet-type cooling systems in the Gillette and Colstrip area as shown in table 22. In addition, the EPA study also reported cost data for mechanical draft dry cooling towers by $/kW capital cost and Mills/KWH total system cost in the Colstrip, Gillette, and Stanton areas as shown in table 23.

TABLE 22

COST OF WET COOLING SYSTEMS

Plant Capital Cost ($/kW)	Fuel Cost (¢/10^6 BTU)	Fixed Charge Rate (%)	Type of Cooling System[1]	Capital Cost Condenser and Pumps	($/kW) Cooling Devise[2]	Total Cooling System Cost[3] (Mills/KWH
300	16	15	OT	4.81	1.25	0.155
			MD	5.13	2.37	0.226
300	16	12	OT	4.97	1.25	0.128
			MD	5.13	2.37	0.182
300	16	18	OT	4.60	1.25	0.180
			MD	5.15	2.37	0.270
300	19	15	OT	4.88	1.25	0.157
			MD	5.13	2.37	0.226
400	19	15	OT	4.81	1.25	0.162
			MD	5.18	2.32	0.244
400	16	15	OT	4.73	1.25	0.160
			MD	5.18	2.32	0.243
400	19	18	OT	4.66	1.25	0.189
			MD	5.13	2.37	0.291

Source: EPA, Special Studies for NGPRP, 1974, Chapter 2.

1/ OT = Once-Through; MD = closed-cycle, wet mechanical draft towers.

2/ For once-through systems, this cost covers intake and outlet structures.

3/ Average annual cost.

TABLE 23

COST DATA FOR MECHANICAL DRAFT DRY COOLING SYSTEMS

Peaking Season	Plant Capital Cost ($/kW)	Fixed Charge Rate (%)	Fuel Cost (¢/10^6 BTU)	Colstrip Tower Capital Cost= $16.5/kW: Total Plant Fuel Cost[1] (Mills/KWH)	Colstrip: Total System Cost[2] (Mills/KWH)	Colstrip: Cooling System Penalty (Mills/KWH)	Gillette Tower Capital Cost= $16.0/kW: Total Plant Fuel Cost[1] (Mills/KWH)	Gillette: Total System Cost[2] (Mills/KWH)	Gillette: Cooling System Penalty (Mills/KWH)	Stanton Tower Capital Cost= $15.4/kW: Total Plant Fuel Cost[1] (Mills/KWH)	Stanton: Total System Cost[2] (Mills/KWH)	Stanton: Cooling System Penalty (Mills/KWH)
		12	16	1.488	2.184	.696	1.488	2.149	.661	1.483	2.132	.649
	300		19	1.767	2.463	.696	1.767	2.428	.661	1.761	2.410	.649
		18	16	1.488	2.494	1.006	1.488	2.445	.957	1.483	2.421	.938
Summer			19	1.767	2.773	1.006	1.767	2.724	.957	1.761	2.699	.938
		12	16	1.488	2.222	.734	1.488	2.186	.698	1.483	2.167	.684
	400		19	1.767	2.501	.734	1.767	2.465	.698	1.761	2.445	.684
		18	16	1.488	2.551	1.063	1.488	2.499	1.011	1.483	2.474	.991
			19	1.767	2.830	1.063	1.767	2.778	1.011	1.761	2.752	.991
		12	16	1.493	1.938	.445	1.493	1.923	.430	1.493	1.905	.412
	300		19	1.773	2.218	.445	1.773	2.203	.430	1.773	2.185	.412
		18	16	1.493	2.149	.656	1.493	2.124	.631	1.493	2.098	.605
Winter			19	1.773	2.429	.656	1.773	2.404	.631	1.773	2.378	.605
		12	16	1.493	1.979	.486	1.493	1.959	.466	1.493	1.940	.447
	400		19	1.773	2.259	.486	1.773	2.239	.466	1.773	2.220	.447
		18	16	1.493	2.202	.709	1.493	2.178	.685	1.493	2.152	.659
			19	1.773	2.482	.709	1.773	2.458	.685	1.773	2.432	.659

Source: EPA, Special Studies for NGPRP, 1974, Chapter 2.

1/ Exclusive of peaking fuel cost.

2/ Includes total plant fuel cost, including peaking costs.

CHAPTER 6: A SUMMARY OF RECENT FEDERAL LAWS AND POLICIES RELATING TO ELECTRIC ENERGY PRODUCTION, WITH A NOTE ON PENDING LEGISLATION AND PROSPECTIVE ISSUES

INTRODUCTION

A collection of existing and prospective Federal laws, regulations, and policies that generally pertain to the production of electrical energy in the United States are reviewed in this chapter. More specifically, Federal legislative actions during the postembargo period, from 1973 to the present, including those under consideration or proposed in the 95th Congress are examined. The basic purpose in this chapter is to compile and summarize, rather than analyze, energy legislation of the recent past, present, and immediate or short-term future.

By selectively presenting legislative actions undertaken at the national level for a period of several years, it becomes possible to discern the broader trends and directions that have been paramount in the development of regulatory and statutory policies for national energy production. The assembly of such a national account also facilitates the comparison of Federal laws, policies, and issues with State energy activities to determine the extent of their agreement. The type of comparison suggested here is essential in developing a more comprehensive and coordinated national energy production effort.

93RD CONGRESS

The 93rd Congress, 1973 to 1974, produced eight laws directly related to the energy development and production issues being explored in this report. The eight laws to be reviewed, accompanied by appropriate annotation, are chronologically arranged to provide a progressive summary of the major Federal legislative actions for the 1973 to 1974 period.

Federal Energy Administration Act of 1974

The Federal Energy Administration Act (Public Law 93-257) established the Federal Energy Administration (FEA) on May 7, 1974. The FEA replaced the Federal Energy Office (FEO), which had been established by Presidential Executive Order in 1973.

Areas of energy responsibility assigned to FEA by the Act encompassed (1) developmental analysis of energy policy, to include operating the National Energy Information Center, forecasting and analyzing energy shortages, and formulating energy policy alternatives; (2) administration of petroleum and natural gas distribution and consumption programs; (3) coordination of energy and national security considerations related to international energy affairs; (4) coordination of energy conservation and environmental protection programs; and (5) responsibility for Project Independence planning.

Specific duties assigned to FEA by the Act included energy resource adequacy assessments for the long-term future, development of shortage management programs, collection and dissemination of energy data and information, development of energy resource import and export policies, and encouragement of State and local participation in energy policy formulation.

Several legislative extensions have prevented FEA, originally established as an emergency interim agency, from being dissolved. The agency is now included as a part of the new U.S. Department of Energy, as established by P.L. 95-91.

Energy Supply and Environmental Coordination Act of 1974

The Energy Supply and Environmental Coordination Act (Public Law 93-319) was passed to provide FEA with the authority to increase the use of domestic coal resources and reduce the demand for gas and imported oil. To achieve this goal, FEA was given the authority to order power plants and industrial fuel-burning installations, with the existing capability, to convert to coal as a primary fuel instead of burning oil or gas. In addition, FEA was authorized to order power plants and major industrial installations in an early phase of planning to be built with the capability to burn coal.

The Act also included provisions that allowed (1) issuance of limited variances from specific Clean Air Act (Public Law 91-609) requirements, (2) certain exemptions to compliance with the National Environmental Policy Act of 1969, and (3) obtaining information about national energy supplies.

Housing and Community Development Act of 1974

Passage of the Housing and Community Development Act of 1974 (Public Law 93-383) represented a consolidation of numerous existing housing and community development programs. Energy-related provisions in the act dealt with both production and conservation. Specifically, the act provided that (1) no federally insured mortgage be approved if new construction does not take advantage of energy conservation techniques, (2) financial institutions be insured for losses sustained in loans for energy conservation improvements and the installation of solar energy systems, and (3) the Department's Secretary should promote the utilization of solar energy for heating and cooling in residential dwellings.

Provisions in the act covering solar energy research and development represented the first of three major solar energy laws passed by the 93rd Congress.

Solar Heating and Cooling Demonstration Act of 1974

The intent of the Solar Heating and Cooling Demonstration Act (Public Law 93-409) was to demonstrate the economic practicability of solar heating and cooling as a necessary first step toward attaining widespread commercial production and marketing of solar heating and cooling systems. To achieve this goal, the law authorized $60 million to be spent over a 5-year period for the commercial demonstration of solar heating and cooling in residential, public, and commercial buildings.

The law provided for (1) the creation of a solar heating and cooling data bank and (2) investigations and studies of legal and other problems associated with the widespread use of solar energy.

Geothermal Energy Research, Development, and Demonstration Act of 1974

The Geothermal Energy Act (Public Law 93-410) established a six-member Geothermal Energy Coordination and Management Project. Purposes of the Project were to (1) conduct a geothermal resources inventory and assessment; (2) recommend pertinent legislation; (3) develop new and environmentally sound production technologies; (4) promote the design and demonstration of various economical types of geothermal plants, including electric power plants; and (5) establish guaranteed loan programs.

Energy Reorganization Act of 1974

The Energy Reorganization Act of 1974 (Public Law 93-438) abolished the Atomic Energy Commission (AEC) and established the Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration (ERDA) in its place. Section 108 of the Law also established an interim interagency coordinating unit known as the Energy Resources Council.

The major purpose of the act was to bring together in one agency all Federal activities relating to research and development on various sources of energy. Another principal purpose of the Law was to separate the regulatory functions of the former AEC from its nuclear energy research and development functions. This was accomplished by assigning all nuclear licensing and regulatory functions to the NRC [(section 201 (f) and (g)].

Title I of the act established ERDA and transferred to the new agency all former AEC functions and powers not expressly given to the NRC. Areas of specific responsibility for ERDA included fossil energy; nuclear energy; environment and safety; energy conservation; solar, geothermal, and advanced energy systems; and weapons research for national security.

The act also transferred to ERDA the responsibilities for (1) the Department of the Interior's fossil fuel energy research and development programs conducted by the Bureau of Mines' energy centers, all functions of the Office of Coal Research, and Interior's functions relating to underground electric power transmission; (2) the National Science Foundation's solar and geothermal energy development programs; and (3) the Environmental Protection Agency's alternative automotive systems research, development, and demonstration activities.

Solar Energy Research, Development, and Demonstration Act of 1974

The enactment of Public Law 93-473 represented the third major piece of solar energy legislation produced by the 93rd Congress. Included as joint purposes in the act were (1) an active program of research and resource assessment of solar energy as a major national energy source and (2) the development and demonstration of practical commercial-scale solar energy projects. All program functions and authorities specified in the act, with the exception of a solar engineering education program, were established as the responsibility of ERDA.

Nonnuclear Energy Research and Development Act of 1974

The Nonnuclear Energy Research and Development Act (Public Law 93-577) was established to provide ERDA with an explicit statement of congressional

policy and principles related to the development of new energy supplies. Specifically, the act required the ERDA administrator to emphasize basic and applied nonnuclear research and development efforts in seven areas: energy conservation and reuse; solar energy; geothermal energy; fossil energy sources to include coal, oil, and natural gas; windpower; ocean thermal power; and hydrogen fuel. The act also mandated the formulation of a comprehensive, environmentally acceptable, long-term energy development strategy.

Section 13 of the act calls for ERDA to obtain the assistance of the Water Resources Council (WRC) to assess the availability of water (and impacts of using it) for the future growth of nonnuclear energy technology. WRC water assessments are required for proposed ERDA demonstration plants for emerging energy technologies, commercial scale energy facilities that would be jointly funded by ERDA and private industry, and for certain regional emplacement of energy technologies, as requested by ERDA.

In addition to the preceeding provisions, the law required that the administrator of ERDA transmit an annual comprehensive energy research, development, and demonstration plan to Congress.

94TH CONGRESS

The energy policy setting prevalent at the beginning of the 94th Congress was characterized by the immediate memory of the Arab oil embargo. Major congressional responses were, despite the acknowledged need for the development of a comprehensive national energy policy and program, limited to three important legislative enactments during the 1975 to 1976 session.

Energy Policy and Conservation Act of 1975

The Energy Policy and Conservation Act (Public Law 94-163) was signed into law December 22, 1975. In its final approved version, the act incorporated a number of varied energy conservation activities.

Title I of P.L. 94-163 extended FEA's authority to direct conversion to domestic coal for power plants and other major fuel burning installations. The title also authorized the creation of a Strategic Petroleum Reserve of up to one billion barrels of crude oil, residual fuel oil, and refined petroleum products, and an Early Storage Reserve of not less than 150 million barrels of crude oil, residual fuel oil, and refined petroleum products. In addition to the other provisions of title I, The President was granted the authority to restrict exports of energy supplies in specified situations.

Titles II and III of the act authorized the President to establish national energy conservation plans, to include establishing mandatory energy conservation performance standards for automobiles and major appliances. Further, title III made available block grants to assist the States in the development and implementation of State energy conservation programs.

Other parts of the law included establishment of a pricing formula for domestically produced crude oil and provisions authorizing increased oil production on Federal lands.

Federal Coal Leasing Act Amendments of 1976

The Federal Coal Leasing Act Amendments of 1976 (Public Law 94-377) became law as a result of a congressional veto override on August 4, 1976. The basic purpose of the 1976 Amendments was to make changes in the provisions established by the Mineral Leasing Act of 1920 that governed the leasing of federally owned coal.

Major sections of the act dealt with coal leasing and use provisions, development and reclamation control measures, and disposition of lease revenues. In particular, the act called for the development of comprehensive land use plans before mining; required the assessment of mining activities on affected communities, the economy, the environment, agriculture, and public services; provided for the issuance of leases only by competitive bidding; increased to 50 percent from 37.5 percent the share of lease revenues allotted to the State in which the lease is located; and required the development and approval of a reclamation plan within three years after a lease was made.

Energy Conservation and Production Act of 1976

The Energy Conservation and Production Act (Public Law 94-385), which became effective August 14, 1976, contained several major energy conservation and production provisions. First, the actprovided for an 18-month extension of the Federal Energy Administration (FEA) until December 13, 1977, as well as changing certain FEA procedures. Second, the act increased congressional oversight of FEA operations. Third, the law provided for the establishment of a broad range of energy conservation measures for new and existing buildings. Last, the act amended the crude oil pricing policy established in the Energy Policy and Conservation Act of 1975 (P.L. 94-163) by removing the 3 percent limitation on the oil production incentive factor.

95TH CONGRESS

The climate surrounding the existing and pending energy-related legislative enactments of the 95th Congress (1977-1978) centers upon an understanding that the Nation's energy problems are interrelated, pervasive, and long-term ir nature. The harsh winter of 1977 and the Nation's widespread shortage of natural gas for industrial, commercial, and residential use has recently served to reinforce the magnitude of the Nation's energy problem. The new Congress and Administration is confronted further with a most difficult problem of attempting to achieve a balance between energy requirements, economic stability, and environmental goals and objectives. With this background in mind, the remainder of this section will examine four major energy laws already enacted during the current session and several other energy proposals now under consideration by Congress.

Enactments of the 95th Congress

- Natural Gas Emergency Act of 1977

In response to the regional natural gas shortages experienced during the past winter, Congress enacted the Natural Gas Emergency Act of 1977 (Public Law 95-2). The Act contains provisions covering the emergency allocation of natural gas supplies during a presidentially declared natural gas emergency, the emergency sale of natural gas at deregulated prices, and the obtainment of

data and information necessary for the President to carry out the provisions of the Act.

• Surface Mining Control and Reclamation Act of 1977

The Surface Mining Control and Reclamation Act (Public Law 95-87) was signed by President Carter on August 3, 1977. Similar legislation controlling the impact of surface coal mining had been vetoed during the two previous Congresses.

While the specific purposes of the act number more than a dozen, the law is essentially intended to encourage the full utilization of all the Nation's coal resources while simultaneously protecting both society and the environment from the adverse effects associated with surface coal mining operations. Major titles and sections in the act pertain to (1) the establishment of an independent regulatory agency, known as the Office of Surface Mining Regulation and Enforcement, within the Department of the Interior; (2) funding of State Mining and Mineral Resources Research Institutes and special research projects; (3) the creation of a federally-administered Abandoned Mine Reclamation Fund, which will allocate or return 50 percent of all operator contributed annual reclamation fees to the State from which the fees were collected; (4) the control of surface coal mining impacts on the environment, the economy, and the supply of coal; (5) the designation of certain lands classified as unsuitable for surface mining operations for minerals and materials other than coal; (6) the designation and funding of 10 University Coal Research Laboratories by the administrator of ERDA; and (7) the provision of graduate student fellowships for studies and research in energy resource curriculums.

The act's strongest control measures appear in title V, "Control of the Environmental Impacts of Surface Coal Mining." In particular, four title V provisions are designed to protect prime farm lands from adverse impacts associated with mining. The four include (1) Mine Application Requirements, Section 507 (b)(16); (2) Permit Approval or Denial Provisions, Section 510(d); (3) Environmental Protection Performance Standards, Section 515(b)(7); and (4) the Release of Performance Bonds, Section 519(c)(2). The act further requires that the Secretary of Agriculture establish and publish the definition of "prime farmlands" as used in the law.

• Department of Energy Organization Act of 1977

As a first step toward formulation of a national energy policy, Congress passed and the President signed into law August 4, 1977, the Department of Energy Organization Act of 1977 (Public Law 95-91). While the law did not include recommendations for policy changes, it did create a new Cabinet-level department designed to reorganize and consolidate the Nation's energy policy, management, and development activities. The establishment of the new Cabinet Energy Department, with both broad responsibility and authority, largely reflects the recognition that national energy problems can only be solved through a comprehensive and centralized administrative approach.

Major titles in the act cover the establishment of the Department, to include specifying 11 broad areas of functional responsibility; the transfer and consolidation of functions from existing energy agencies, offices, and administrations; the creation of a Federal Energy Regulatory Commission to

establish energy resource pricing rules and regulations; and a requirement that the President submit a 10-year energy production and conservation plan to Congress biennially.

Major energy resource and policy areas of Department responsibility encompass fuel supply and leasing procedures, research and development, environment, international energy policy, national security, intergovernmental relations, competition and consumer affairs, nuclear waste management, energy conservation, power marketing, and public and congressional relations.

Major energy agency activities consolidated by the new law include all functions of the Federal Energy Administration (FEA), the Energy Research and Development Administration (ERDA), and the Federal Power Commission (FPC). Other authority transfers to the Department of Energy (DOE) include the Bureau of Reclamation's power marketing function, the Bureau of Mines' data gathering building conservation standards authority, the Interstate Commerce Commission's oil pipeline regulation authority, the Defense Department's authority over oil and oil shale reserves, and the Department of Commerce's authority for industrial energy conservation programs.

- Clean Air Act Amendments of 1977

The Clean Air Act Amendments of 1977 (Public Law 95-95) were signed into law August 7, 1977. The major provisions in the Law that relate to electric energy production are contained in title I, "Stationary Sources." Specifically, the title contains provisions covering nonattainment, industrial compliance, and new source standards.

In the case of industrial compliance, the Law contains provisions that permit stationary sources to obtain delayed compliance permission for up to three years from the States or the Environmental Protection Agency (EPA). Further, the act extended the national ambient air quality attainment standards until December 31, 1982.

In addition, the amendments revised the previous set of new source performance standards. In particular, boilers fed by fossil fuels will be required to use the best available control system for emission reductions as a step toward compliance. The law also permits the granting of waivers from the new source performance standards on an individual unit or source basis.

Pending Legislative Proposals

- National Energy Policy Act

On August 5, 1977, the U.S. House of Representatives passed and sent to the Senate for its consideration the President's National Energy Policy Act proposals (House Resolution 8444). The House-passed version of the original bill emphasized a major theme of energy conservation, to include reductions in the demand for oil and gas, coal substitution, increased energy efficiency and conservation, and increases in energy fuel prices.

In addition to the conservation emphasis provided by H.R. 8444, numerous House energy policy and development bills were incorporated or substituted in the final approved version that was forwarded to the U.S. Senate. Three House bills substituted for original portions of the President's proposal are particularly germane to the subject of this report and deserve further discussion. The three bills are the Electric Utility Act of 1977 (H.R. 5841), the Small Hydroelectric Power Act of 1977 (H.R. 7417), and the Cogeneration and Waste Heat Utilization Act of 1977 (H.R. 6661 and S. 1363).

The Electric Utility Act of 1977 included as section 451 of H.R. 8444, represents an attempt to increase efficiency in the production and use of electric energy. Specific provisions of the bill require that (1) FPC prescribe rules covering the reliability of electric energy generation and transmission, (2) FPC prescribe rules encouraging cogeneration, (3) all utilities prepare and provide to FPC annual long-range plans specifying future bulk power facilities, and (4) FPC be empowered to establish centrally dispatched power pools within a region and, when needed, order exchanges of energy, interconnection, wheeling, and other transmission services between utilities.

The Small Hydroelectric Power Act of 1977 included as chapter 6, title I of H.R. 8444, contains provisions to increase the capability for hydroelectric power production at more than 49,000 existing small dams. To this end, the bill is designed to establish an incentive program that will provide grants of up to 50 percent of project costs.

The Cogeneration and Waste Heat Utilization Act of 1977 was introduced as identical bills in the Senate (S. 1363) and the House (H.R. 6661) and has been included as section 546 in H.R. 8444. If enacted, this legislation would place new empahsis on energy conservation through the recovery and use of industrial waste heat to produce both steam and electricity. Various sections of the bill include provisions for industrial incentives, research and development, and a waste heat energy resource recovery policy analysis.

- Amendments to the Energy Supply and Environmental Coordination Act of 1974

Several bills have been introduced to amend the Energy Supply and Environmental Coordination Act, as amended, in the 95th Congress. The two major bills that have been submitted include the Natural Gas and Petroleum Conservation and Coal Utilization Policy Act of 1977, introduced as S. 977, and the Coal Substitution Incentive Act of 1977, introduced as H.R. 7473.

S. 977 is currently under consideration by the full Senate. Major provisions in the bill include strict prohibitions on the burning of oil and natural gas by new electric power plants and new major industrial plants which burn fuel at a rate of at least 100 million Btu's per hour, the issuance of temporary and permanent conversion exemptions, the provision of direct loans by FEA to help power plants and factories install air pollution control equipment, and authorizations for FEA to provide money to coal production regions designated as "energy impacted areas" for the purposes of developing area services and conducting study impact planning.

The proposed House bill (H.R. 7473), while similar in ultimate purpose to S. 977, is designed to establish fiscal incentives for the conversion of existing power plants and other fuel burning installations to coal as a primary energy source. Essentially, the bill authorized the provision of

direct loans and loan guarantees by FEA for the purchase and installation of the air pollution control devices necessary to achieve compliance with air quality standards by existing power plants and factories converting to coal.

- Coal Pipeline Act of 1977

The Coal Pipeline Act of 1977 (H.R. 1609) was introduced during the first session of the 95th Congress for the purpose of amending the Mineral Leasing Act of 1920. If passed, the bill would grant the right of eminent domain to carriers of coal by slurry pipeline. The acquisition of lands owned by the United States or by any State and the lands held in trust by the United States for the Indian tribes are specifically excluded from the exercise of the power of condemnation. In addition, the bill requires that the Secretary of the Interior make independent determinations on the extent to which any project covered by the act would help meet national coal utilization objectives, disrupt the environment, and affect the water requirements of the area from which the coal would be transported.

Future Issues

- National Land Use Legislation

One of the major legislative issues facing the 95th Congress is that of developing a comprehensive national land use planning and assistance bill. The development of such a national land use policy and planning act is not a enacting national legislation designed to aid the States in formulating and implementing land management programs. The situation in the 95th Congress will be no different from the eight preceeding congressional sessions.

At the present time, it is anticipated that a national land use planning and assistance bill will be introduced during the second session of the current Congress. While it is difficult to predict in advance exactly what the bill will seek to accomplish, it appears evident that provisions covering energy facility siting will provide a major cornerstone of the bill's comprehensive planning process. It is further anticipated that the bill will include incentives for the energy industry in the form of simplified Federal review of new facilities.

In effect, the energy facility siting provisions of the forthcoming land use bill probably will be quite similar to those contained in a comparable section of the 1976 Senate land use proposal (S. 984). Major program emphasis will continue to be centered on multiple purpose land use planning, with considerable importance placed on the siting of all energy facilities, to include refineries, pipelines, liquified natural gas facilities, and fossil and nuclear power plants.

CHAPTER 7: STATE ENERGY POLICIES, LAWS, AND REGULATIONS

This chapter presents a review and summary of energy policies, institutional arrangements, and legal statutes and regulations pertaining to electric power for each of the 10 basin States. Therefore, it represents, to a large degree, a State complement to the Federal laws reviewed in chapter 6.

The information presented in this chapter is arranged in two major sections: State energy policy and program organization; and general and specific State statutes pertaining to energy development and electric power. Each State's individual activities will be briefly summarized under those chapter headings.

STATE ENERGY POLICY AND PROGRAM ORGANIZATION

Colorado

In early 1977, the State of Colorado completed preparation of its 4-year, statewide Energy Conservation Plan, as provided for by title III of P.L. 94-163. The overriding intent of the plan, developed according to FEA's national guidelines, is to increase conservation and efficiency in the end-use of all forms of energy by both the public and private sectors in the State. Specifically, the comprehensive State Energy Conservation Plan calls for an 8 percent reduction in the projected 1980 energy consumption level in Colorado. Attainment of the 8 percent figure would represent a substantial improvement over FEA's mandatory planning requirement of a 5 percent consumption reduction.

The final version of the plan incorporates a series of 24 voluntary, educational, and mandatory program measures to realize the overall planning objective. Moreover, the plan includes five broad elements designed to further State energy conservation efforts. These include (1) training and technical assistance programs in the State's commercial and industrial sector; (2) programs relating to State government operations; (3) programs covering new construction, renovation, and weatherizing of buildings; (4) public and agricultural education programs; and (5) programs relating to transportation. Finally, the plan strongly recognizes the immediate need to begin converting to renewable alternative sources of energy.

The State of Colorado is presently in a transition stage with respect to its internal organization for energy policy and program management. At present, Harris D. Sherman, Executive Director of the Colorado Department of Natural Resources (DNR), is largely responsible for most State energy activities. In addition to several DNR energy agencies (Oil and Gas Commission, Division of Mines, Mined Land Reclamation, and the Geological Survey), the State's Energy Conservation staff functions under Mr. Sherman's direction. The address for obtaining additional energy activity information in Colorado is as follows:

Harris D. Sherman, Executive Director
Department of Natural Resources
718 Centennial Building
1313 Sherman Street
Denver, Colorado 80203

To supplement energy activities of the DNR, the Governor of Colorado formed an Energy Planning Coordinating Council in January 1976 to oversee interdepartmental energy policy and program analyses.

Iowa

Preparation of the Iowa Energy Conservation Plan: 1977-1980 was completed in early 1977 by the Iowa Energy Policy Council. In addition to statewide programs to investigate new energy sources and improve Iowa's total energy system, the conservation plan is intended to enhance the overall energy situation in the State by reducing energy needs in 1980 by at least 8 percent. To achieve this goal, the plan details 67 voluntary and mandatory conservation program measures for the State's 9 energy consumption sectors: agriculture, government, transportation, utilities, industries, construction, mining, commercial, and residential. Further, the plan incorporates four of FEA's five mandatory energy conservation programs: lighting efficiency standards for public buildings; promotion of availability and use of carpools, vanpools, and public transportation; energy standards affecting State and local procurement practices; and thermal efficiency standards for new and renovated buildings. Because Iowa had inaugerated a "right turn on red after stop" provision in 1975, additional energy savings realized as a result of this mandatory program were not incorporated into the conservation plan.

Specific programs to affect direct energy savings in the electric utility sector that have been outlined by the plan include promotion of cogeneration of electricity and heat (space heat and process heat), promotion of collocation of utilities and potential industrial users of waste heat, revision of State regulations that limit electric transmission line routes, development of new rate schedules for natural gas connections, utility advertising to encourage energy conservation, the use of solid waste as a utility fuel, and utility development of load controls. Exact quantitative estimates of the end use energy savings for all utility sector programs were not projected in the plan because of the tentative nature of the suggested policy changes.

The major task of developing energy policies and carrying out energy programs in Iowa was delegated to the State's newly formed Energy Policy Council in 1975. The 15-member council, composed of members of the public and State officials and legislators, and its staff have been substantially involved in an extremely broad range of State energy activities since the creation of the agency. In particular, the council has worked to identify State concerns relating to various energy issues, to develop a working knowledge of many complex energy matters, to establish a statewide energy policy and energy conservation program, to assist in the formulation of the State Water Plan, and to expand the State's energy research and technology program. One of the council's major future activities will involve developing energy management implementation plans and encouraging the establishment of governmental policies that are consistent with State energy policy objectives.

The Energy Policy Council's staff presently functions under the direction of Rodson L. Riggs. Further information concerning the council's activities can be obtained directly from the council:

Iowa Energy Policy Council
707 East Locust Street
Des Moines, Iowa 50319

Director: Rodson L. Riggs

Kansas

The Kansas Energy Conservation Plan was completed and submitted to FEA in June 1977. The overall goal of the Conservation Plan is to realize a reduction of 6.9 percent in the total amount of energy consumed in the State by 1980. As required by FEA, the plan contains four of five mandatory energy saving programs, to include lighting efficiency standards; carpooling, vanpooling, and public transportation measures; thermal efficiency standards for buildings; and improved government procurement practices. Further, the plan emphasizes that significant energy savings can be achieved in the transportation, agricultural, electric utility, residential, industrial, and government operations sectors by implementing a wide mix of voluntary conservation initiatives. In particular, the plan indicates that the greatest amount of energy can be saved in residential, industrial, and electric utility uses. The plan also incorporates energy conservation opportunities offered by materials recycling and the development of alternative energy sources.

The Kansas Energy Office is responsible for developing programs and policies pertaining to State energy production and management and acts as the focal point for all State energy activities. Specific duties of the office presently include the development and improvement of public education and awareness programs; the collection and dissemination of energy information; supervision of the State fuel allocation program; serving as an intergovernmental, industrial, commercial, and public liaison; and the control of Federal energy development and management funds provided to the State. Further information about State energy programs can be obtained directly from the energy office:

Kansas Energy Office
Second Floor
503 Kansas Avenue
Topeka, Kansas 66603

Acting Director: Steve Harris

Minnesota

The Minnesota Energy Conservation Plan, submitted to the Federal Energy Administration on March 28, 1977, represents one of the most far reaching strategies proposed among the 10 basin States. If the energy conservation measures proposed in the plan are successfully implemented, it is estimated that the State can reduce its energy consumption during calendar year 1980 by 124.0×10^{12} Btu. This energy savings would represent a reduction of 9.5 percent over the projected consumption for that year.

Like the other basin States, Minnesota has integrated the necessary FEA mandated programs into its energy conservation approach. In addition, the plan contains 24 phase I program measures, representing those efforts with the most immediate and greatest potential for savings; 19 phase II program measures,

representing in several instances continuations of phase I measures; and 7 phase III program measures.

Three program measures, in particular, relate to utility conservation efforts. During phase I, the State has proposed a Fuel Use/Efficiency Inventory for combustion devices. As a follow-on, the Fuel Use/Efficiency Inventory is slated for continuation during phase II. Another study, to be conducted during phase II, will examine the potential for electric energy cogeneration.

The Minnesota Energy Agency has the responsibility for directing numerous State energy activities and programs. Foremost among the agency's responsibilities are an information and education program; the provision of service assistance to local areas and units of government; the development and analysis of State energy policy; the operation of a centralized energy data system; the supervision of State energy research activities; the development of energy demand and supply trends and forecasts, and an emergency fuel allocation plan; certification of the need for all large energy facilities; the development of a State energy conservation program; and the preparation of a biennial State energy policy and conservation report. The State energy agency has also been involved in preparing and submitting energy-related legislative proposals to the State legislature for their consideration and action. Additional information pertaining to the State's energy activities and programs can be obtained directly from the Minnesota Energy Agency:

Minnesota Energy Agency
Room 740
American Center Building
160 East Kellogg Boulevard
St. Paul, Minnesota 55101

Director: John P. Millhone

Missouri

By realizing all the energy conservation objectives established in a recently prepared State Energy Conservation Plan, Missouri would reduce its projected 1980 energy consumption by 5.2 percent. The State's basic purpose in pursuing a strong energy conservation approach, as outlined in the plan, is to reduce waste and to end the inefficient use of energy in the State.

As submitted to FEA, the Missouri plan contains a series of 14 program measures that, when implemented, will effectively achieve the State conservation goal. Collectively, the 14 measures include 5 FEA-mandated responses and 9 voluntary conservation activities.

In addition to program measures covering the residential, industrial, commercial, State and local government, transportation, agricultural, and resource recovery sectors, the plan includes a variety of energy conservation management approaches specifically targeted at the utility sector. The utility conservation measures covered in the plan largely emphasize the reformation of existing utility policies that encourage the use of excessive quantities of energy.

Specific State actions proposed in the plan include (1) the proposed establishment of a program where gas and electric utilities would actively promote and provide assistance in residential conservation efforts, to include

weatherstripping, installing automatic thermostats, and increasing insulation levels; (2) the issuance of a required certificate of residential and commercial structure energy efficiency prior to permitting building hook-ups to utility service; (3) restrictions on master-metering for new commercial buildings and multifamily dwelling units; (4) the promotion of a load management program to encourage ripple control, power pooling, and rate restructuring by time-of-day and interruptible rates; and benefit/cost evaluation of small-scale power generation facilities, cogeneration, and waste heat recovery; (5) controls on the nonessential use of lighting; and (6) a requirement that utilities develop energy conservation materials and promote energy conservation education and public awareness.

The State of Missouri's Energy Program is located within the Division of Policy Development in the Department of Natural Resources. The agency's mission is basically to assist the State in meeting its energy needs by recommending or developing laws, programs, procedures, and policies that assure the wise and efficient use of energy. The agency has adopted three basic goals which currently are among the highest priority objectives of the Department of Natural Resources: (1) to promote State utilization of alternate energy resources for industry, business, institutions, and residential customers; (2) to develop and maintain program capability to effectively manage State energy supply and distribution problems; and (3) to reduce energy consumption by 5.2 percent of the State's 1980 projected energy use. In addition to the Energy agency, several ad hoc advisory bodies such as the Governor's Commission on Energy Conservation, the Committee of Building Technology Advisors, the Weatherization Advisory Committee, and a solar advisory group serve the Department and the Energy agency with technical advice and recommendations.

Additional information concerning State energy activities in Missouri can be obtained from the State energy program:

Missouri Energy Program
Department of Natural Resources
P.O. Box 1309
Jefferson City, Missouri 65101

Program Director: Weston A. Fisher

Montana

With the completion of The Montana Energy Conservation Plan, the conservation of energy emerged as the keystone of Montana's intermediate and long-term energy policy. Fifteen discrete program measures are contained in the plan and are intended to promote the efficient utilization of energy in the State. The collective product of the successful implementation of all 15 measures is anticipated to result in a 6.5 percent reduction in Montana's overall energy consumption in 1980. By category, the 15 measures include 9 mandatory programs, 5 incentive programs, and 1 educational program.

The program measure in the Montana plan that is most germane to this report involves mandatory energy conservation efforts in the public utility sector. Three specific elements, which could jointly produce a savings of approximately 30 percent of the State's 6.5 percent energy use reduction goal, comprise the mandatory utility conservation measure. The three include undertaking a utility rate structure study, designed to determine whether the efficient use

of energy is encouraged under present rate schedules; encouraging industrial cogeneration of process heat and electricity; and initiating energy audits of large commercial and industrial utility customers.

Supervision of energy-related activities in Montana are divided between two State agencies. Most of the State's major energy management endeavors reside with the Montana Energy Office. In particular, the office is involved in fuel allocation and energy conservation programs and in the formulation of the State's energy policy. A separate State office, the Energy Planning Division of the Department of Natural Resources and Conservation, is responsible for administering Montana's Major Facilities Siting Act. More detailed information on the programs of each agency can be obtained directly from the individual offices:

Montana Energy Office
State Capitol
Helena, Montana 59601

Director: Bill Christiansen

Energy Planning Division
Department of Natural Resources and Conservation
32 South Ewing
Helena, Montana 59601

Division Administrator: Bob Anderson

Nebraska

The Nebraska Energy Conservation Plan, completed in early 1976, incorporates a combination of 19 mandatory, optional, and State-developed energy conservation measures in an attempt to realize an approximate 7.3 percent end-use energy savings in 1980. In addition to five FEA-mandated programs, the plan includes conservation measures covering residential and agricultural energy use efficiency, solid waste management, used oil recycling, conversion of agricultural materials to combustible fuel, production of methane gas from feedlot wastes, electric vehicle and mass transit demonstration projects, production of gasohol, driver education and training programs, liberalization of limits on truck size, encouragement of the use of automatic electric demand control devices in residences, measurement of carbon monoxide emissions and engine performance during annual motor vehicle inspections, promotion of public awareness programs to voluntarily reduce energy use in public buildings, and electrical load leveling practices.

Specific plan proposals related to load leveling in Nebraska's electric utility sector encompass two basic programs. First, the plan endorses a 1,000-megawatt pumped-storage hydroelectric power plant proposed for development by the Nebraska Public Power District (NPPD) on the Missouri River. A second measure set forth in the plan involves the shifting of irrigation load demands to off-peak hours. The total energy savings to be achieved by implementing both measures would account for almost 21 percent of the State's 1980 conservation goal.

In response to the Arab oil embargo in 1973, Nebraska established an Office of Petroleum Allocation within the Department of Revenue. The duties

of the Office were transferred in 1976 when the State Energy Office was established by Executive Order. In turn, the Nebraska Unicameral established the State Energy Office as a formal independent agency of State government September 2, 1977.

The State Legislature assigned the following duties to the newly vested agency:

(1) to serve as or assist in developing and coordinating a central repository within State government for the collection of data on energy;

(2) to undertake a continuing assessment of the trends in the availability, consumption, and development of all forms of energy;

(3) to collect and analyze data relating to present and future demands and resources for all sources of energy and specify energy needs for the State;

(4) to recommend to the Governor and the legislature energy policies and conservation measures for the State and to carry out the measures that are adopted;

(5) to inform and educate the public about energy and energy alternatives;

(6) to accept, expend, or disburse funds, public or private, made available to and for research studies, demonstration projects, or other activities which are related either to energy conservation or development;

(7) to study the impact and relationship of State energy policies to national and regional energy policies;

(8) to actively seek the advice of the citizens of Nebraska regarding energy policies and programs;

(9) to prepare emergency allocation plans suggesting to the Governor actions to be taken in the event of serious shortages of energy;

(10) to design a State program for the conservation of energy.

The law further provides the State Energy Office with the authority to adopt rules and regulations; to enter into agreements and contracts; to participate in the activities of organizations of States relating to the availability, conservation, development, and distribution of energy; to engage in activities that will insure that the State of Nebraska receive an equitable share of energy supplies at a fair price; to form advisory committees; and to provide an annual report to the Governor and the legislature on a calendar year basis.

Further information about energy activities and programs in the State can be obtained directly from the Nebraska Energy Office:

Nebraska Energy Office
P.O. Box 94841
Lincoln, Nebraska 68509

Director: George J. Dworak

In addition to the activities of the Nebraska Energy Office, the State utilizes the Governor's Energy Advisory Committee to extend a broader base of energy advise to the Governor, to coordinate State energy activities, and to provide State government guidance on energy policy and planning matters. The committee was formed by the Governor in December 1976.

North Dakota

On March 28, 1977, the North Dakota Office of Energy Management and Conservation submitted the State's official 4-year Energy Conservation Plan to FEA. As stated in the plan, the State's specific energy conservation goal is to reduce North Dakota's 1980 energy consumption by 7.5 percent, or by an amount equivalent to 12.33 trillion Btu's.

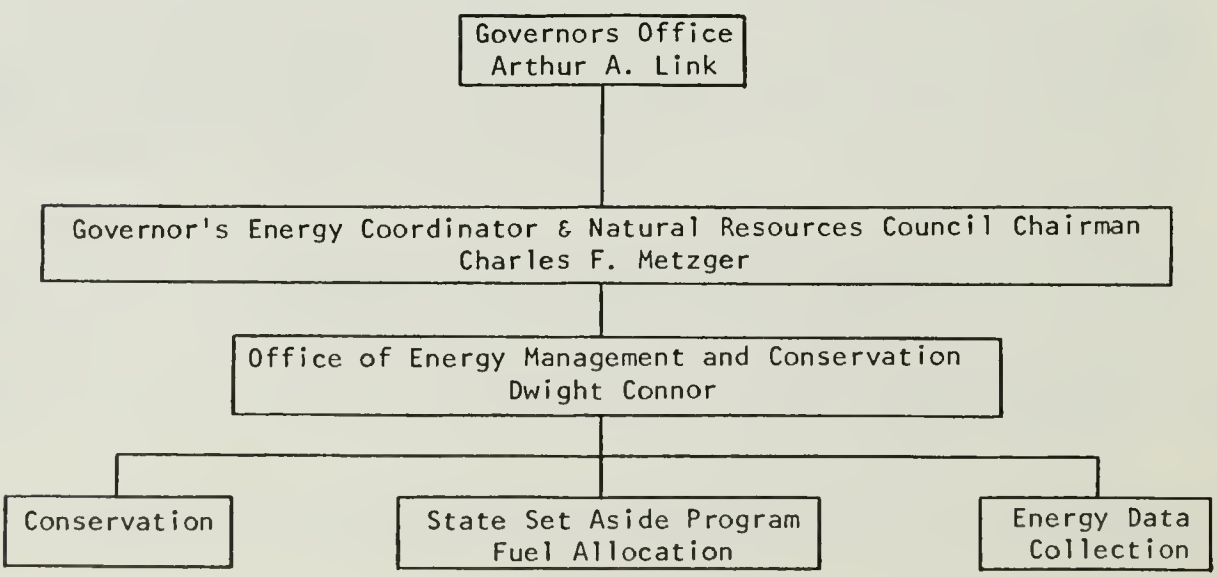
In its present form, the North Dakota Energy Conservation Plan incorporates five FEA-mandated conservation measures, as well as voluntary programs in the agricultural, residential, industrial, and State government sectors. In all program measures, the State has strongly recognized the need for a public education component.

Conservation programs that specifically involve North Dakota electric utilities include conducting a computerized audit of energy use in single family, owner-occupied homes through a program titled "Project Conserve," and instituting an effective load management program through Project UCAN (Utilities Conservation Action Now).

Major energy activities in North Dakota fall within the purview of the State's Office of Energy Management and Conservation. Specific responsibilities of the office include coordination of energy and conservation programs throughout the State, development and collection of energy availability and fuel consumption data, and administration of the State's fuel allocation program. The administrative position of the office within North Dakota's governmental organization is shown in figure 9.

FIGURE 9

ENERGY ORGANIZATION IN NORTH DAKOTA STATE GOVERNMENT



Additional information about energy policies and programs in North Dakota can be obtained directly from the State Energy Office:

Office of Energy Management and Conservation
Third and Main Streets
Bismarck, North Dakota 58505

Director: Dwight Connor

South Dakota

In an attempt to specify immediate solutions to recent energy problems and to guide future energy conservation activities, the State Office of Energy Policy (OEP) prepared and submitted a Comprehensive Energy Conservation Policy Plan for South Dakota to FEA in March of 1977. The overall goal of the plan is to reduce projected gross energy consumption increases for 1980 by 6.2 percent. If realized, the reduction would result in a per capita energy savings of 19 million Btu's in 1980.

In developing the plan, OEP identified seven major areas (six consumption sectors and a public education component) in which conservation measures and activities could be implemented: (1) agriculture, (2) commerce/industry, (3) energy suppliers, (4) residences, (5) State/local government, (6) transportation, and (7) public education. The designation of 61 individual conservation program measures for the seven sectors, when combined with FEA's five mandatory programs, serves to solidify the State's two-fold conservation strategy of producing immediate energy savings through improving energy use efficiency and educating the public on the long-term need to conserve energy resources. Additional policy approaches emphasized in the plan include the development of alternative and renewable energy resources and State cooperation in devoting special attention to the needs of South Dakota's native American population.

Six specific conservation programs have been proposed for the energy suppliers sector in the South Dakota Conservation Plan. The six include expansion of four existing conservation programs and the introduction of two new programs. The four existing programs to be expanded consist of (1) the use of remote sensing thermograms to detect building heat loss; (2) the provision of building weatherization incentives by energy utilities; (3) the development of conservation plans, containing measures such as those recommended in FEA's Conservation and Load Management (CALM) Program, by energy suppliers; and (4) utility efforts to shift electric loads to off-peak demand periods. The two new programs include conducting energy audits and encouraging cogeneration through planned facility siting.

The responsibility for State energy management was assigned to the South Dakota Office of Energy Policy by Executive Order of the Governor in July 1974. The authority delegated to the office includes administration of the State set-aside program for fuel allocation, promotion of energy conservation, collection and dissemination of information necessary to formulate energy policies, and evaluation of State energy policies and programs. The office was also assigned the task of preparing the State's Energy Conservation Policy Plan. Further information on South Dakota's energy programs can be obtained directly from the energy policy office:

Office of Energy Policy
Sigurd Anderson Building
Pierre, South Dakota 57501

Director: James Van Loan

Wyoming

A 7.5 percent reduction in projected energy consumption could be realized by 1980 in Wyoming if the program measures outlined in the State's Energy Conservation Plan are successfully implemented. The State Plan, submitted to FEA in March 1977, outlines 12 primary and numerous secondary programs to achieve the 7.5 percent reduced consumption goal.

Primary program measures for the industrial sector, which includes electrical utilities, are projected to account for 75 percent, approximately 21 trillion Btu's, of the State's overall energy savings in 1980. Specific utility measures include primary program efforts to increase the efficiency of plant operations and secondary program activities covering utility rate reforms and utility siting for cogeneration and waste heat recovery purposes.

Major responsibilities for energy management in Wyoming are assigned to the State's Mineral Development Division, Department of Economic Planning and Development. Energy-related activities of the Division include administrating the Fuel Allocation Program under FEA, preparing energy production and consumption projections, providing technical advice to the State Energy Conservation Coordinator, and working with industry and other agencies on energy matters. Currently, the Governor's office Press Secretary serves as the State Energy Conservation Coordinator. More information on State energy policy and programs can be obtained directly from the Secretary or from the Chief of the Mineral Development Division whose address is:

Mr. John Goodier
Mineral Development Division
Department of Economic Planning and Development
Barrett Building
Cheyenne, Wyoming 82002

Specific questions about the State's Energy Conservation Plan can be addressed to the Energy Conservation Coordinator, Wyoming Energy Conservation Office, Capitol Hill Office Building, 25th and Pioneer, Cheyenne, Wyoming 82002.

State Summary

A summary of the energy conservation objectives for each of the 10 basin States is presented in table 24. The table also shows the estimated quantity and percent reduction in energy use based on 1980 projections and lists the energy coordinator for each State.

TABLE 24

STATE ENERGY CONSERVATION OBJECTIVES

State	% Reduction by 1980	1980 Savings In Trillion Btu's	State Coordinator
Colorado	8.0	64.40	Harris D. Sherman
Iowa	8.0	81.04	Rodson L. Riggs
Kansas	6.9	76.66	Steve Harris
Minnesota	9.5	124.00	John P. Milhonne
Missouri	5.2	130.20	Weston A. Fisher
Montana	6.5	23.93	Bill Christiansen
Nebraska	7.3	44.51	Larry Riegel
North Dakota	7.5	12.33	Dwight Connor
South Dakota	6.2	10.71	James Van Loan
Wyoming	7.5	28.06	Lynn Dickey
TOTAL	N/A	595.84	N/A

STATE ENERGY LAWS AND REGULATIONS

A wide variety of laws and regulations covering land use, environmental quality, and energy facility siting operate in conjunction with similar Federal requirements and controls in the 10 Missouri River Basin States. For example, State power plant siting laws complement Federal laws requiring that (1) all nuclear power plants be licensed by the Nuclear Regulatory Commission; (2) all plants encroaching on a navigable stream obtain a permit from the U.S. Army Corps of Engineers; and (3) any power plant or transmission line must be licensed by the Federal Energy Regulatory Commission if it is located on or crosses any public land or land and water over which Congress has jurisdiction. Other Federal laws to which most States have developed (or will develop) counterparts include the recently amended Clean Air Act of 1970, the Federal Water Pollution Control Act Amendments of 1972, the Surface Mining Control and Reclamation Act of 1977, and the Flood Plain Management Act of 1968.

The remainder of this chapter reviews existing State laws covering land use, to include power plant siting and transmission line locations, controls on the extraction of energy fuels and flood plain management; and environmental quality, including air and water pollution control related to the production of electric power.

Colorado

- Energy Facility Siting

The Colorado Public Utilities Commission (PUC) is responsible for granting a certificate of public convenience and necessity before any public utility can begin the construction or improvement of a 100 MW or larger power plant or

a 115 kV or greater transmission line. In addition to the requirements of the PUC, the State Engineer must approve any plan involving the construction of a reservoir with storage in excess of 1,000 acre-feet or a dam higher than 10 vertical feet, and the State Ground Water Commission must approve any application to appropriate ground water for beneficial use.

A variety of local controls exist as legal constraints to the siting and development of energy facilities. These include the police powers of establishing county subdivision regulations, developing county zoning and building codes, applying local land use planning, executing local zoning regulations, authorizing planned unit developments, and enforcing county rights-of-way regulations.

- Land Use Control

In 1974, the Colorado Legislature passed a State land use statute (HB 1041). Under provisions of the law, local governments may adopt regulations covering the use of land resources in various hazard areas, including flood plains, wildfire, and geological (land slides and avalanches) areas. The law also contains provisions for reviewing and regulating mineral resource areas; areas around key facilities which may have a significant impact; and historical, natural, and archeological resource areas.

- Environmental Quality

The Colorado Department of Health's Water Quality Control Commission administers a State permit system to regulate the discharge of pollutants into any State water. All commission activities to classify State waters, develop water quality standards, and promulgate pollution control regulations comply with the requirements of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) and, therefore, must include the regulation of thermal discharges from electric generating plants. The Commission is presently holding hearings on a revision of State water quality standards, which includes 72 parameters.

Under the Colorado Air Pollution Control Act of 1970, as amended in 1973, the Air Pollution Control Commission of the Colorado Department of Health is responsible for requiring that all available practical methods to reduce, prevent, and control air pollution be employed. The Colorado Act also requires that a construction permit be issued when any new or substantially altered facility, except single family dwellings, constitutes a new air contamination source or an indirect air contamination source.

Iowa

- Energy Facility Siting

Before the construction or significant alteration of any electric power generating plant with 100 MW or greater installed nameplate capacity and its associated transmission lines may begin, the Iowa State Commerce Commission must issue a certificate of public convenience, use, and necessity covering the action. Procedures involved in the issuance of the required certificate include the filing of an application and the appropriate information with the Commerce Commission and the scheduling and convening of a prehearing conference, an information meeting, and a public hearing. As a result of the information obtained from the applicant and other interested parties, the Commerce Commission decides, on the basis of an established set of criteria, whether the application should

be amended, denied, or approved. If the certificate is approved, the applicant is granted the necessary right of condemnation.

A second important aspect in power plant siting relates to the availability and use of water required for condenser cooling. In Iowa, the Natural Resources Council (INRC) must grant a water permit before water can be consumed for the generation of electricity. Specific water use considerations cover:

1. Surface sources (river & streams):

   Withdrawals may be permitted during those periods when the discharge of the river is above the "protected flows" established by the INRC. During periods when the discharge of the river is below the protected flow, withdrawals are permitted only if an amount of water equal to the consumptive use at the generating facility is supplied to the river from an auxiliary source such as a reservoir or other suitable source.

2. Shallow ground water sources:

   Withdrawals may be permitted provided they are not:
   (a) detrimental to any public interests or the interests of property owners with prior or superior rights, or
   (b) detrimental to the flow in rivers or streams. (Such withdrawals would then be subject to the protected flow restrictions in 1 above.)

3. Deep ground water sources:

   Withdrawals from deep ground water sources are generally discouraged unless the water is of such a quality so as to be of little or no value for uses other than cooling. These deep formations may have slow rates of recharge and mining of water with declining piezometric levels could result from large withdrawals. In any case, condition 2a would apply.

Further, the amount of water authorized by permit must be consistent with industry-wide usage for the same or similar purposes.

- Land Use Control

The Iowa Natural Resources Council is charged with the responsibility for establishing flood plain encroachment limits and approving applications for the construction of structures to be built in the flood plain and floodway. This control extends to power plants wishing to locate in the flood plain adjacent to a source of cooling water and to any levees or dikes necessary to protect a generating station from flooding.

- Environmental Quality

The Water Quality Management Division of the Department of Environmental Quality is responsible for ensuring that thermal discharge standards, established under Section 400.16 3(3) of the Iowa Administrative Code, are not violated. The Department is also responsible for establishing acceptable water use designations for creeks, streams, and rivers in Iowa.

The Air Quality Management Division of Iowa's Department of Environmental Quality is charged with controlling atmospheric pollution in the State. In particular, the Division requires the granting of a State permit for fossil fuel-fired steam generators with more than 250 million Btu's per hour heat input rate.

Kansas

- Energy Facility Siting

Under Kansas law (KSA 66-1, 158-661, 169; dated July 1, 1976), any electric utility wishing to construct a new plant or expand on an existing facility must obtain a permit from State Corporation Commission. Such permits are issued only after notification to affected landowners and State agencies and after holding public hearings.

- Land Use Control

The State of Kansas has adopted rules and regulations and has issued technical guidelines covering surface mining activities. Additionally, the State is in the process of establishing eligibility for participation in the National Flood Insurance Program.

- Environmental Quality

The generation of electricity must comply with all the State environmental quality laws, rules, and regulations administered by the Kansas Department of Health and the Environment.

Minnesota

- Energy Facility Siting

The Minnesota Environmental Quality Board (EQB) is responsible for certifying all electric generating plants of 50 MW or greater capacity and any 5 MW or greater generating plant that burns oil, natural gas, and natural gas liquids. Only plants of the 50 MW or greater size come under the siting jurisdiction of the EQB. The Board further requires the preparation of an environmental assessment prior to the construction of electric generating plants at a single site that is designed for or capable of operating at 200 megawatts or more capacity.

The EQB is also charged with certifying the need for and routing high voltage transmission lines at capacities above 200 kV and with ensuring compliance with utility forecasing requirements.

- Land Use Controls

The reclamation of mineral lands in Minnesota is covered by sections 93.44 to 93.51 of the Minnesota State Statutes. Statutory applicability to energy fuels is limited to the mining of peat.

Control over the use of land in the flood plain is the responsibility of the State's Department of Natural Resources, as assigned under the Flood Plain Management Act, Minnesota Statutes 104.01 to 104.07.

In addition, Minnesota employs a State-established mechanism to coordinate State land use-related problems in an effort to promote optimum management of lands under State jurisdiction.

- Environmental Quality

Efforts to control the effects of power plant heated discharged are designated as the responsibility of the Minnesota Pollution Control Agency, under the State's Water Pollution Control Act (Minnesota Statutes 115.01 to 115.09).

Missouri

- Energy Facility Siting

The Missouri Public Service Commission (PSC) maintains jurisdiction over the manufacture of electricity in the State. As a result, the permission and approval of the PSC is necessary before any electric generating plant may be constructed. Such approval is based on whether the facility is necessary or convenient for public service. The commission is also responsible for investigating the methods and nature of energy supplies and ordering service improvements when necessary.

- Land Use Control

Missouri's Land Reclamation Law became effective in March 1972. Prior to the act becoming effective, the Missouri Legislature created a Land Reclamation Commission in 1971 to enforce the pending law. Under recent reorganization, responsibility for the land reclamation program was placed within the Missouri Department of Natural Resources (DNR). The commission is still responsible, however, for establishing the reclamation policies to be carried out by DNR. Under the law, industries mining coal (or other minerals) must obtain a permit to surface mine; the permits are issued for only a specific number of acres. Further, a performance bond is required for any acreage covered by permit to insure that land reclamation will be completed. Each company mining coal is also required to submit a comprehensive water management plan explaining what provision will be made to control erosion and runoff.

At present, the State of Missouri is enrolled as an eligible community participant in the National Flood Insurance Program, and the program is administered by the DNR. Unfortunately, local community control over building permits and codes, as required for participation in the Federal insurance program, has been slow to evolve because of the unpopularity of local planning and zoning authorities in predominantly rural portions of the State.

- Environmental Quality

The Missouri Clean Water Act was passed in 1972. Under the law, the Clean Water Commission establishes State water quality policy, which is then implemented by DNR. Based on the present State water quality standards covering

temperature, thermal effluents may not elevate or depress the temperature of the stream more than 5 degrees F. In addition, the stream temperature shall not exceed 90 degrees F due to effluents. For reaches of streams designated for stocking or propagation of trout, the temperature shall not be elevated more than 2 degrees F due to effluents. No activity of man shall cause reaches of streams used for stocking or propagation of trout to exceed 68 degrees F. Additionally, no elevation in the temperature of lakes shall be due to effluents. (The standards recognize that Lake Springfield and Thomas Hill Reservoir were constructed especially to provide industrial cooling water, and so will have a mixing zone of heated water.) Additional control over effluent discharge problems is provided by the State's participation in the NPDES permit program.

The Missouri Air Conservation Commission, established by the State's 1965 Air Conservation Law, is charged with preventing, abating, and controlling air pollution. Policies and regulations resulting from Commission action are implemented by the DNR. In addition to controlling the firms already established in Missouri, the commission controls new firms and activities locating in the State. Prior to the construction of any new air contaminant source or modifications to existing sources, firms must first obtain a permit for construction from DNR. New source performance regulations recently issued by the Air Conservation Commission cover 12 source categories including power plants.

Montana

- Energy Facility Siting

In 1975, Montana adopted the Major Facility Siting Act, which amended the Montana Utility Siting Act of 1973. Under the Major Facility Siting Act, certain energy generation, conversion, and transmission facilities must receive a certificate of environmental compatibility and public need before they can be constructed. Examples of facilities included within the jurisdiction of the act are:

(a) electrical generating plants of capacity 50 MW or larger;

(b) plants capable of producing at least 25 million cubic feet of gas per day or 25,000 barrels of liquid hydrocarbons per day;

(c) plants capable of utilizing, refining, or converting at least 500,000 tons of coal per year;

(d) transmission lines of design capacity of more than 69 kilovolts, except for lines of capacity 230 kilovolts or less and 10 miles or less in length;

(e) pipelines which carry gas, water, or liquid hydrocarbon products to or from a facility covered by the act which is located within or without Montana; and

(f) any facility for underground in-situ gasification of coal or for any use of geothermal resources.

Any person desiring certification for a facility covered by the act must file an application together with a filing fee with the Department of Natural Resources and Conservation. The filing fee is based upon the estimated construction costs according to a schedule in the act. After the application is filed, the department has one or two years, depending upon the facility proposed, to study the application, issue a draft environmental impact statement (EIS) on the proposed facility, solicit public input to the draft EIS, and issue a final EIS. With the final EIS, the department also issues its recommendations to the Board of Natural Resources and Conservation concerning whether certification should be granted or denied for the proposed facility, or granted for a modified facility.

The Board of Natural Resources and Conservation is a quasi-judicial board of citizens appointed by the Governor. Certification authority rests with the board. Within 120 days of the receipt of the Department's recommendations, the board must initiate public hearings on the proposed facility. During the hearing, the applicant must prove, by clear and convincing evidence, that there is a need for the facility, and that the facility will achieve the minimum adverse environmental impact considering the state of available technology and the nature and economics of the various alternatives. Additionally, the act specifies environmental and other criteria that must be given consideration during the hearing. Within 90 days after the last day of the hearing, the board must issue its decision either granting, modifying, or denying the application.

Although the act supersedes all conflicting State laws and unreasonably restrictive local laws, a Montana District Court Ruling has indicated it is not truly a "one stop" siting mechanism. The act specifies that prior to the issuance of a certificate by the Board of Natural Resources and Conservation, the "...duly authorized State air and water quality agencies..." must certify that the proposed facility would comply with all existing air and water quality standards. The Montana court has ruled that any party aggrieved by an air or water quality certification decision of the Department of Health and Environmental Sciences can request a hearing before the Board of Health and Environmental Science. Again, the final certification authority rests with the board rather than the department.

- Land Use Control

The Montana Strip and Underground Mine Siting Act empowers the State, through a permit system, to review new coal and uranium strip mine or underground mine site locations and reclamation plans. Following review, the State has the authority to either approve or disapprove such locations and plans.

In addition, the Strip and Underground Mine Reclamation Act empowers the State, also through a permit system, to require and approve a mining, reclamation, revegetation, and rehabilitation plan for all coal and uranium strip mining and underground mining operations. The law specifies that an applicant must file a bond of from $200 to $2,500 per acre or fraction of an acre of land to be affected by the proposed operation with the State to obtain a permit. The performance bond is released by the State as the provisions of the permit are satisfied.

• Environmental Quality

The Montana Water Pollution Law permits the State Department of Health and Environmental Sciences to establish and modify the classifications of all waters in accordance with their present and future beneficial use, to establish water purity standards, to regulate discharges to State waters through a permit system, to monitor discharges and water quality, and to enforce the established standards. At present, thermal discharge standards have been established by water use classification for all State waters (MAC 16-2.14 (10) - S14480).

The Montana Clean Air Act permits the State to establish, monitor, and enforce emission and ambient air standards. The act also prohibits the construction, installation, alteration, or use of any machine, equipment, device, or facility that may directly or indirectly cause or contribute to air pollution or that is intended primarily to prevent or control the emissions of air pollutants unless a permit is first obtained. Fuel burning equipment limitations for particulates, visible air contaminants, sulfur oxide emissions, and ambient air quality standards are contained in the Montana Administrative Code as sections 16-2.14 (1) - S1450, 16-2.14 (1) - S1460, 16-2.14 (1) - S1470, and 16-2.14 (1) - S14040, respectively.

Nebraska

• Energy Facility Siting

Nebraska does not have a utility siting statute. The State does, however, have a permit and licensing law. Further, all electric utilities serving Nebraska are public districts organized under appropriate State statutes. Therefore, they are controlled by boards of directors elected by the public and are subject to statutes regulating subdivisions of State government. In addition, the operation of these utilities are subject to regulation by the

The Power Review Board has statutory power to authorize or deny the construction of transmission lines and related facilities outside of the corporate limits of cities and villages. It also has the authority to require public power districts, municipalities, and other retail power suppliers to enter into service area agreements and to enforce these agreements.

The use of surface water is controlled primarily by a statutory system providing for the appropriation of water for beneficial purposes, including the production of electric power, but a number of court decisions still recognize the validity of some limited riparian rights. Under Nebraska's appropriation system, rights to the use of surface water are based on appropriation to a beneficial use, first in time being first in right, subject to the approval and regulation of the Department of Water Resources. In addition, an appropriator using water for power must lease the water from the State through the Department of Water Resources. When the water supply in the stream is not sufficient for the use of all appropriators, preference is given to different types of uses as follows: (1) domestic, (2) agricultural, (3) manufacturing. However, a junior agricultural appropriator may take water used for power production only if just compensation is paid.

Use of ground water for power production is subject only to general restrictions on wells. All wells, including those for manufacturing and

industrial use, must be registered with the Department of Water Resources and are subject to certain restrictions on spacing from adjacent wells. As in the case of surface water, industrial wells are given third priority in the preference system. Recently enacted statutes provide a system for establishing more restrictive controls in specially designated control areas with severe ground water problems. These control areas, administered by Natural Resources Districts, could place more severe restrictions on the use of water for power production, but there has been no experience with such systems to date.

- Land Use Control

State and local land use regulations are in effect for flood plain areas of the State. Local political subdivisions and the State have the authority to deny or to require modification of structures located within a designated 100-year floodway.

- Environmental Quality

All power plants owned and operated by public districts are subject to regulation of the Nebraska Department of Environmental Control and appropriate Federal agencies. In particular, the Department of Environmental Control handles the State's air quality regulations and is empowered to enforce water quality standards in the State.

North Dakota

- Energy Facility Siting

The North Dakota Public Service Commission has the administrative authority to oversee compliance with the State's Energy Conversion and Transmission Facility Siting Act. To carry out the provisions of the law, the North Dakota Century Code specifies a process involving the development of 10-year plans, public hearings, certification and permit procedures, the approval of specific sites and routes, and the nature and contents of individual facility development plans.

Priorities of water use are articulated in chapter 61-04 of the North Dakota Century Code. A property right to such water is established only after application of the water to a beneficial use. At the time of application for a water permit, the applicant is granted a priority in time by the State Water Commission. This priority in time is, of course, erased should the application not be approved. The State does have the authority to set aside or reserve specific quantities of water through a "Declaration of Intent."

- Land Use Controls

North Dakota's Reclamation of Strip Mined Lands Act expresses the legislature's intent:

> To provide, after surface mining operations are completed, for reclamation of affected lands to encourage productive use including but not limited to: the planting of forests; the seeding of grasses and legumes for grazing purposes; the planting of crops for harvest; the enhancement of wildlife and aquatic resources; the establishment of recreational, home, and industrial sites and for the conservation,

development, management, and appropriate use of all of the natural resources of such areas of compatible multiple purposes; to aid in maintaining or improving the tax base; and protecting the health, safety, and general welfare of the people, as well as the natural beauty and esthetic values, in the affected areas of this State.

It is also intended that reclamation practices required by this act restore mined lands designated for agricultural purposes to the level of inherent productivity equal to or greater than that which existed in the permit area prior to mining (38-14 of the North Dakota Century Code, chapter 318 of North Dakota Session Laws, 1975). Other stipulations in the law cover requirements for public hearings, establishment of standards, issuance of permits, and provisions for penalty. All provisions of the law are administered by the State's Public Service Commission.

- Environmental Quality

The North Dakota Health Department is responsible for administering both the State's "Control, Prevention, and Abatement of Pollution of Surface Waters" (61-28 of the North Dakota Century Code) and "Air Pollution Control" (23-25 of the North Dakota Century Code) laws. Stipulations are contained in each law to require standards establishment and the issuance of State permits.

South Dakota

- Energy Facility Siting

Chapter 49-41B of the South Dakota State Code, known as the Energy Facility Permit Act, relates specifically to the State's permit and licensing procedures for energy conversion and transmission facilities. All provisions of the law relevant to both large and small energy facilities are administered by the South Dakota Public Utilities Commission. While the law does not delegate to the commission the authority to route a transmission line or to designate or mandate the location of an energy conversion facility, it does require that the proposed facility not pose a serious injury to the environment and the social and economic condition of the area or substantially impair the health, safety, and welfare of the area's inhabitants if a construction permit is to be granted.

Recently, several pieces of proposed legislation covering water use preference priorities have been presented for consideration by the State legislature. Most such legislation establishes water use appropriations for power generation, known as utility use, as an intermediate preference. Furthermore, most proposed legislation addresses water use preferences by river basin, as well as the transfer of water rights.

- Land Use Control

Regulations covering surface mining activities are administered by the South Dakota State Conservation Commission. The commission is also responsible for controlling water quality problems caused by erosion.

Wyoming

- Energy Facility Siting

The State Industrial Siting Council is assigned the responsibility of regulating the siting of energy and conversion facilities under the Wyoming Industrial Development and Siting Act. Under Wyoming Statute 35-503.72 to .94, energy generating or conversion plants capable of generating 100 megawatts or greater of electricity; facilities producing 100 million cubic feet of synthetic gas a day, 50,000 or more barrels of oil a day, or enriching 500 or more pounds of uranium a day; or plants with an estimated cost of $50 million or more before being developed are required to be authorized by a permit issued by the council. All pertinent factors, including environmental and socioeconomic impacts, are taken into account before the issuance of a permit. The permitting procedure also provides for the conduct of public hearings near the vicinity of the proposed facility.

Regulatory jurisdiction over public utilities is the responsibility of the Wyoming Public Service Commission (PSC). Under Wyoming Statute 37-31, the commission must issue a certificate of public convenience and necessity before the construction or extension of a line, plant, or system can be undertaken.

The administration of water use in Wyoming is based on a State constitutional provision that the waters of all natural streams, springs, lakes, or other collections of stillwater within the boundaries of the State are declared to be the property of the State. Therefore, the acquisition of the water rights that would be required for any energy development would have to be made in accordance with Wyoming Statute 41-1 to 532. Specifically, section 41-138 applies to appropriation of underground water and section 41-201 applies to surface water appropriation. In addition, State water use legislation specifies procedures for filing an application, establishment of proof of beneficial use, and the subsequent adjudication of water rights.

- Land Use Control

The State of Wyoming has established a mechanism to coordinate State land use-related problems. Further, the State requires local governments to establish a mechanism for land use planning. The State has also adopted rules and regulations covering surface mining and the application of land reclamation measures.

- Environmental Quality

The Wyoming Environmental Quality Act of 1973 (W.S. 35-502.16 - .20) establishes the criteria for standards to be maintained and procedures of administration of air, land, and water quality in the State. The basic concept of the law is that no person, except when authorized by permit, shall cause, threaten, or allow the discharge of any pollution or waste into any waters of the State. Similar concepts apply to air and land quality control.

CHAPTER 8: STATE WATER AND ENERGY CONCERNS

This chapter addresses four water and energy issues of significant concern within the Missouri River Basin. The four issues were identified from information contained in chapter 6 of the 1975 "Status of Electric Power in the Missouri River Basin" report and, as such, represent some of the most urgent energy problems, needs, and issues facing the 10 basin States. The four issues addressed in the remainder of the chapter cover:

(1) the role of the Northern Great Plains in energy development;
(2) the transfer of water and the allocation of water between competing uses;
(3) increasing water and energy demands versus efforts to conserve water and energy; and
(4) the role of water in balancing industrial economic growth with environmental preservation.

The attention given to each problem should serve to help identify the resources required to implement the necessary State and regional responses. State positions will be summarized individually under each issue.

THE ROLE OF THE NORTHERN GREAT PLAINS IN ENERGY DEVELOPMENT

Colorado

The State of Colorado expressed six major concerns relating to the State's role in national energy development and production. The six are:

(1) a potential exists for serious wildlife habitat impacts to emerge;
(2) community impacts resulting from energy development must be mitigated;
(3) an economic balance between the agricultural, mining, and tourism sectors should be maintained;
(4) requirements for urban recreation needs must not be overlooked;
(5) a comprehensive analysis of the impacts of proposed development upon the total water resources of the region, as well as site-specific water resource impacts, must be undertaken; and
(6) detailed regional analyses of environmental, economic, and social impacts and costs are required if the optimum process of coal development is to be identified.

Iowa

The State of Iowa receives considerable amounts of power from the basin power system, which serves a dual purpose by providing both water and energy produced from water. However, water cannot afford to be traded or lost to gain energy. In particular, the critical water needs of the western third of Iowa must be protected by maintaining optimum water conditions before maximizing power production.

Kansas

Coal resources within the State of Kansas are being utilized where production is considered economically possible. However, out-of-State coal resources provide the bulk of fuel requirements to fulfill State needs. Some controversy over the environmental impacts of coal production have arisen.

Minnesota

Increased coal traffic from the Northern Great Plains area to Minnesota and through Minnesota is causing increased concern primarily in rural areas of the State. Unit train traffic is seen as a disruption to local communities primarily due to conflicts at rail-highway crossings and incompatible land use requirements. Some rural inhabitants are particularly upset over the apparent trend of building large generating facilities in rural Minnesota and over the building of transmission lines connecting generating plants in North Dakota to bulk transmission facilities in Minnesota.

Montana

Montana's major concern over energy development in the Northern Great Plains region is the level of future compliance with the State's reclamation law. Overall, the Montana Legislature has mandated that the State does not want a level of development that is greater than that needed for Montana's own requirements. The State will, nonetheless, allow coal to be mined and shipped out. Shipment of coal by slurry pipeline is prohibited by the Montana Water Use Act.

Nebraska

Nebraska has a vital concern regarding the development of Great Plains coal. Even though the coal reserves are not found within the State, the mining of coal in other areas can have serious effects on water depletions. Other secondary effects can also be experienced.

Nebraska has recently shown concern over water depletions of a power plant on the Laramie River in Wyoming. Water utilized by the power plant will decrease the amount of water available at the State line that has previously been used for irrigation purposes.

The Nebraska Legislature has not enacted legislation to permit the use of eminent domain for slurry pipelines. There has been some concern that such legislation would set a precedent and cause the transport of vast amounts of water to other areas of the country.

North Dakota

Major concerns in North Dakota are focused in three areas:

(1) Effects on other land uses - transfer of use, reclamation, etc. The farming and the livestock industry have been the foundation of North Dakota's economy and will continue to be so in the future. In the western part of the State, where the lignite is located, agriculture consists of a combination of small grain production and short grass ranching. Considerable concern - which manifests itself as opposition to lignite development - exists over the potential long-range changes in land use brought about by mining, particularly because of what are believed to be uncertainties regarding mined-land reclamation and the disruption of rural domestic water supplies. Mining activities could impact irrigation development in western North Dakota, but that impact would likely stem from the disturbance of land rather than from competition for water.

(2) Coal use and transportation. North Dakota has never been formally approached (water permit application) regarding coal slurry pipelines. There has been, nevertheless, concern expressed about the concept since water exportation is involved. Yet, in discussions during the Yellowstone Level B Study when the question of slurry pipelines interfaced with the prospect of increased rail traffic, coal slurry lines gained some support. The use of brackish water as a transporter has been suggested as one way of mitigating the water question.

(3) Effects on Water Depletions. It is anticipated that by 1985, 25.2 million tons of coal will be mined in the Missouri Basin portion of North Dakota and will be used to produce approximately 4,076 MW of power. This will require about 56,000 acre-feet of water annually for consumptive use. At this level of development, there is little concern that water supplies are sufficient to meet foreseeable energy demands or that industrial demands will infringe on other sectors, particularly agriculture.

South Dakota

Because of the low quality of the State's coal resources and the small quantity of its oil and gas reserves, it is not anticipated that South Dakota will be a large supplier of energy. However, it is anticipated that the State will be impacted by the effects of energy development in adjoining States.

Wyoming

With large coal deposits in the State, there is no alternative but to expect that production will increase. Of greatest concern to the State is the extent to which this will increase and the effect the increase will have on small rural communities. During periods of development, demands on local capacities would be stressed to provide needed services. This will be coupled with the potential that overproduction of community facilities could result in surpluses subsequent to development that could not be maintained and would be a burden to the community. Ideally, a coal-export policy might be preferred; however, the capacity of transportation facilities is limited, and total railroad transport could rapidly become prohibitive by disrupting the order of communities through which railroads are routed. Expansion of energy production facilities in essentially all forms will impact on water supply availability requiring possible reallocations to fulfill the needs of these expanded uses. Until a definite determination is developed relative to the magnitude and classification of development and what might be expected to be supplied from the State's resources, the problems and issues of socioeconomic impacts and utilization of the resources will continue to be matter of concern that will have to be resolved on a more or less short-term basis.

THE TRANSFER OF WATER RIGHTS AND THE ALLOCATION OF WATER BETWEEN COMPETING USES

Colorado

Whether there will be enough water for all needs, including water for energy production and energy conversion such as oil shale retorting, is a concern voiced by many people in Colorado. Water rights are getting more and more costly and difficult to secure in order to ensure a firm water supply when and where it is needed.

The allocation of water among the various uses--irrigation, energy production, municipal, and industrial--is an issue that will need to be settled in the future. Diversion of Western Slope water to the Eastern Slope is another issue to be settled. Western Slope interests feel the water is needed for electric power production, as well as for coal and oil shale production on the Western Slope. A concern has also been expressed that the zero discharge goal set by the FWPCA Amendments of 1972, if implemented as planned by 1983, will cause water supply problems for downstream users.

The Public Utilities Commission has encouraged utilities to coordinate their system planning to minimize the need for short-term solutions on individual systems and the operation of less economical generation units. Such planning would also give the maximum benefits to the consumer and create a minimum amount of environmental impacts.

Iowa

Energy production is one of the many competing uses for Iowa's water resources. Water is used in many aspects of energy production including mining and reclamation of mined lands, processing and refining of fuels, conversion of a fuel into another form of energy, and disposal of any waste products. Withdrawals of water for dissipating the waste heat from thermal-electric plants is by far the largest category of water use in the energy industry.

Even though Iowa is not in a region where water supplies are expected to be critically short, there will still be water resource problems and conflicts involved with meeting the water needs of the expanding energy industry and other beneficial users.

Kansas

The conversion of water use from agricultural to industrial purposes will probably become a major issue in Kansas. Under current State law, such a conversion could be made, but it would be accomplished only at a price that would probably result in new problems. This issue has recently surfaced in a conflict over the water supply contract for one of the State's power companies. The issue is also being debated by the Kansas Legislature.

Minnesota

Conflicts in water use are not currently a problem in Minnesota. However, future consumption is expected to cause significant problems under current allocation schemes. The State is presently developing a set of feasible water allocation policy alternatives which will be the basis for a new water allocation policy.

Missouri

In addressing the Second Annual Missouri River Basin Governors' Conference, Governor Joseph Teasdale summarized his State's position on competing uses for water. Basically, the Missouri position recognizes the importance of giving full and equal consideration to all water uses, to include energy development.

Montana

As yet, Montana has not experienced any major transfer of water to energy development. Therefore, this is not currently a major issue. Any future requests for transfers will have to be approved by the State's Department of Natural Resources.

Nebraska

Nebraska's water laws do not have great flexibility for the transfer of water uses or the allocation of water between competing uses. As the energy demand for water grows, this area must receive additional State consideration.

North Dakota

Three areas appear salient to the issue of water use transfers in North Dakota:

(1) Extent (Volume) of Transfers and the Allocation of Water Between Competing Uses. Water permits are granted on a priority in time basis in North Dakota. The right to use water passes from one owner to another provided that the use does not change. A change in use would require action by the State Engineer. Recent records indicate that rights to a small amount of water have been transferred from irrigation to municipal use. It is not anticipated that the transfer of the right to use water for other purposes will be a common practice in the near future.

(2) Alternative to Transfers. In light of the above response, consideration has not been given to the issue of other alternatives except in a very general sense.

(3) Status and Form of State Policy on Future Water Use Allocations Currently Being Developed or Contemplated, Adaptability of State's Water Rights and Legal Systems. Legislation was introduced during the last legislative session to change the "priority in time" system to a "priority by use" system. The legislation did not pass, but the fact that it was introduced may signal the beginning of efforts to change the current system.

South Dakota

A very strong public conflict has begun to emerge over the use of water for energy development as opposed to other beneficial uses in South Dakota. Such concerns have been especially prominent for proposals covering the use of water for the transportation of coal by slurry pipeline.

Wyoming

In order to support any degree of expansion of energy production in the State, some reallocation of water will have to be made or new sources of supply will have to be developed from other than conventional sources. With an economy that has been based primarily on agriculture, any appreciable expansion of energy production will necessarily involve trade-offs of water allocation and use with agricultural activities. Regardless of the measures employed to resolve the issue of industrial needs, there may still be a need to transfer water rights.

Conservation of energy related to the total national demand can affect significant savings that will no doubt be applied to oil and gas fired plants; however, demand on coal as a source of energy fuel is anticipated to continue to increase. Future water use allocation will depend on multiobjective planning and development to assure an acceptable balance among the various uses. Future policies will largely be directed toward an emphasis on water and energy conservation.

INCREASING DEMANDS FOR WATER AND ENERGY VERSUS CONSERVATION

Individual State efforts and programs intended to reduce energy consumption levels, and therefore the quantities of water required for energy production, were examined in chapter 7.

Colorado

Due to recent drought conditions, a State drought council and regional drought councils have been formed by the Governor to address the measures to be adopted for water conservation. Generally, these measures will be voluntary, cooperative efforts to conserve water, both in the short and long terms. These efforts will be coordinated with those identified in the State energy conservation plan.

Iowa

The State of Iowa recognizes the possibility that there are times when protected flow requirements will affect energy production. It is believed, however, that this problem can be precluded by merging energy development and energy conservation planning. Further, by reducing demands for energy, demands for water can also be reduced and conservation of both energy and water can be realized.

Minnesota

Minnesota is aggressively pursuing energy conservation. The State has put a tough building code applicable to all buildings into effect. Further, the State legislature is examing mandatory retrofitting of existing buildings at point of sale. During the last legislative session, the State legislature established minimum air conditioner performance standards. The State is also developing maximum lighting standards for all publicly-used buildings. Additionally, the State is examing hot water district heating as a way of making power plants more efficient, thereby reducing water requirements and making Minnesota more energy and water efficient.

Nebraska

Nebraska is becoming very aggressive in the area of energy conservation, and due to drought conditions, the State is beginning to identify water conservation opportunities and activities. With the rapid advancement of irrigation development in the State, the establishment of long-range energy and water conservation and management policies is essential.

North Dakota

North Dakota strongly supports the conservation of both water and energy. Generally speaking, it is the position of the administration that North Dakota

is disinclined to encourage lignite development on a massive scale because of a lack of commitment at the national level to an energy policy embodying a strong conservation ethic.

Water conservation in North Dakota, as implied and stated explicitly in the statutes, means using but not wasting. As it pertains to ground water, the statutes now contain a requirement that all ground water wells for irrigation must be metered. Surface water storage and utilization are integral parts of water conservation in North Dakota for municipal, domestic, irrigation, and other uses.

Wyoming

The evolving need to develop alternate means of energy production, along with climactic conditions, resulting in periods of below average water supply, has given emphasis to the need to conserve energy and water. Conservation practices will have to be employed in order to assure that supplies will be adequate to fulfill demands of the most critical needs to the extent possible. Studies and evaluations are continually underway to determine the amount and sources of water that may be available in the future for various defined needs. A concerted program has been started which is directed towards conservation which initially will be on a voluntary basis.

THE ROLE OF WATER IN BALANCING INDUSTRIAL ECONOMIC GROWTH WITH ENVIRONMENTAL PRESERVATION

Colorado

Colorado has not tried to address the issue of the role of water in balancing industrial economic growth with environmental preservation directly. However, the Governor, in a number of decisions regarding water developments, has favored limiting the use of water already dedicated to agricultural uses. For the Dallas Creek project, the Commissioner of the U.S. Bureau of Reclamation has been requested to redesign the project so that it would not include water for industrial development. The project would, instead, provide water for agricultural and municipal use only.

Minnesota

Minnesota is presently developing a feasible set of water policy alternatives which will be the basis for a new State water policy.

Montana

The Montana Legislature enacted the Yellowstone Moritorium to give State and Federal agencies and local units of government the opportunity to file for water use reservations that would take precedence over pending applications for water permits to be used in energy development and production. The moritorium for the Yellowstone River Basin has been extended to January 1978. Further, an unsuccessful attempt was made during the last legislative session to establish a water use preference system which designated municipal and domestic uses first in preference, agricultural uses second, and instream requirements (fish and wildlife, recreation, and water quality) third in priority.

Nebraska

State involvement has been very minimal in balancing industrial economic growth with environmental preservation. Future water planning efforts will consider the relationship between these two areas.

North Dakota

In North Dakota, water could play an important role in balancing industrial economic growth and environmental preservation in a number of ways. First of all, a decision not to grant a water permit for industrial development inherently results in some degree of environmental preservation. In cases where mining has occurred and where reclamation is underway, water could play an important role in restoring an area to its before-mining condition through the use of irrigation during times of critical stress on emerging plant growth.

Maintenance of assured "instream flows" has the potential to dampen industrial development in some areas, particularly in those where importation is either unfeasible or socially unacceptable. North Dakota law does not classify such instream flows as a beneficial use, but it is interesting to note that there is growing sentiment to do so. The preliminary draft of the Yellowstone Level B Study calls for maintenance of flows up to 50 percent of average in the Western Dakota tributaries where possible.

Wyoming

Water will be of increasing importance in providing a measure of control over industrial growth for which, at least for the time being, the State's water rights and legal systems are sufficiently adaptable and adequate to administer most matters.

APPENDIX I: BULK POWER SUPPLIERS SERVING THE MISSOURI RIVER BASIN

Sixteen interstate and intrastate pooling organizations conduct individual and joint power planning throughout a large portion of the Missouri River Basin. A detailed listing of member composition and the specific functions and activities of each of the 16 pooling associations is presented in this appendix.

MID-CONTINENT AREA POWER POOL (MAPP)

MAPP was formed by 22 Midwest generation and transmission systems in February 1963 to promote integrated regional planning. Originally known as the Mid-Continent Area Power Planners, the organization's membership was expanded in 1972, and its present name was adopted. MAPP is presently composed of 23 members and 12 associate participant supply systems that represent investor-owned utilities, public power districts, cooperative systems, municipal electric systems, and a Federal system. MAPP develops broad plans for expansion of generation and high capacity interconnections. Detailed planning for specific facilities is performed by the individual systems or subgroups that will build or operate them. Current participation in MAPP from the Missouri River Basin includes 17 member systems and 1 associate participant:

MRB Members

Basin Electric Power Cooperative
Central Iowa Power Cooperative
Cooperative Power Association
Corn Belt Power Cooperative
Interstate Power Company
Iowa Electric Light and Power Company
Iowa Power and Light Company
Iowa Public Service Company
Iowa Southern Utilities Company
Minnkota Power Cooperative, Inc.
Montana-Dakota Utilities Company
Nebraska Public Power District
Northern States Power Company
Northwestern Public Service Company
Omaha Public Power District
United Power Association
U.S. Bureau of Reclamation-Upper Missouri Region-Eastern Division

MRB Associate Participants

Lincoln (NE) Electric System

MISSOURI BASIN SYSTEMS GROUP (MBSG)

Early in 1963, the U.S. Bureau of Reclamation and representatives of over 100 preference-type (publicly owned) power systems executed the Missouri Basin Systems Group Pooling Agreement that led to the formation of a power planning group called the Missouri Basin Systems Group (MBSG). MBSG is concerned with both regional planning and with pooled operation. Its membership is composed of a large number of municipal electric systems, rural electric cooperatives, and the U.S. Bureau of Reclamation. Its two objectives are to achieve coordinated planning for provision of the major power facilities (including thermal generation and high voltage transmission) required to meet the growing needs of the systems group members beyond those met by the Federal hydroelectric system, and to provide for coordinated operation of the wholesale power supply system. An example of this coordinated effort is the 1,500-megawatt Laramie River bulk power facility currently being

planned for Platte County, Wyoming. When completed, generation from the plant will be used to meet member system requirements throughout the basin. Seventy members of the MBSG's total membership of 104 operate within the basin:

MRB Municipal Members

Iowa
Akron
Anita
Atlantic
Corning
Denison
Harlan
Harley
Hawarden
Hinton
Kimballton
Lake Park
Lenox
Manilla
Mapleton
Milford
Onawa
Orange City
Paullina
Primghar
Remsen
Rock Rapids
Sanborn
Shelby
Sibley
Sioux Center
Stanton
Villisca
Woodbine

Minnesota
Adrian
Luverne

Nebraska
Lincoln

South Dakota
Aberdeen
Arlington
Beresford
Burke
Estelline
Faith
Langford
Madison
Miller
Parker
Pierre
Tyndall
Volga
Watertown
Wessington Spring

MRB Power Supply Organizations

Colorado
Platte River Power Authority

Iowa
L&O Power Co-op
Northwest Iowa Power Co-op

Kansas
Northwest Kansas Power Agency
North Central Kansas Power Agency

Montana
Upper Missouri G&T

Nebraska
Loup Public Power District
Nebraska Electric G&T
Tri-State G&T
Tri-State G&T

North Dakota
Basin Electric Power Co-op
Central Power Electric Co-op

South Dakota
East River Electric Power Co-op
Rushmore Electric Power Co-op

MRB Distribution Cooperatives Members

Kansas
Flint Hills Rural Electric Co-op
Sunflower Electric Co-op

North Dakota
KEM Electric Co-op
Mor-Gran-Sou Co-op
Oliver-Mercer Electric Co-op

South Dakota
FEM Electric Assn., Inc.
Grand Electric Co-op
Moreau Grand Electric Co-op

Federal Agencies
U.S. Bureau of Reclamation

State Agencies
Nebraska Dept. of State Institutions
University of Nebraska

ASSOCIATED MOUNTAIN POWER SYSTEMS (AMPS)

AMPS is a planning group that performs studies of transmission interconnections which would make possible more efficient use of existing generating facilities. It also studies the scheduling of future generating facilities, coordination of generating plant operations, and improvement of service continuity. The group has a jont Engineering and Operating Committee. Member companies have entered into a contract to construct certain transmission ties as a result of the coordinated planning of the group. AMPS is comprised of five systems, of which three companies operate within the Missouri River Basin:

MRB Members

Idaho Power Company
The Montana Power Company
Pacific Power & Light Company

MISSOURI-KANSAS POOL

The Pool agreement, executed on March 28, 1962, provides for the further interconnection of the member systems, the sharing of reserve supply, the exchange of standby service, and a continuing operational and administrative relationship to achieve operating economies and reliability through coordinated planning and operation.

In June 1965, three additional contracts (the Missouri Facilities Agreement, the Kansas Facilities Agreement, and the Missouri-Kansas Coordination Agreement) were executed providing the strong 345 kV interconnection facilities to increase interchange capability between the Pool's seven members:

MRB Membership

Kansas City Power & Light Company
Missouri Public Service Company
The Empire District Electric Company
Kansas Gas & Electric Company
The Kansas Power & Light Company
Central Telephone & Utilities Corporation -
  Western Power Division
Central Kansas Power Company

PLATTE RIVER POWER AUTHORITY

The Platte River Power Authority is a four-member planning and operating group. It is involved in the construction of transmission facilities to provide delivery of power to its members and participation by the members in the construction of jointly owned coal-fired generating plants:

MRB Membership

City of Fort Collins, Colorado
City of Loveland, Colorado
City of Longmont, Colorado
City of Estes Park, Colorado

COLORADO POWER POOL

The primary purpose of the Colorado Power Pool is the sharing of reserves between four members. Only one of the four members operates within the basin:

MRB Membership

Public Service Company of Colorado

INLAND POWER POOL

The Inland Power Pool is a seven-member coordinating group within the State of Colorado and provides joint planning for reliability:

MRB Membership

Public Service Company of Colorado
USBR Regions 4 & 7
Tri-State G&T Association, Inc.
Platte River Power Authority

IOWA POOL

The Iowa Pool is a six-member coordinating group within the State of Iowa and provides for joint planning for reliability in the area:

MRB Membership

Iowa Electric Light and Power Company
Iowa Power and Light Company
Iowa Public Service Company
Iowa Southern Utilities Company
Corn Belt Power Cooperative

PACIFIC NORTHWEST COORDINATION AGREEMENT (PNCA)

The PNCA group coordinates the operation of power resources and transmission facilities under a long-term (35 years) agreement executed in 1964 between 16 signatory parties. The group determines the firm load carrying capability of the interconnected systems in accordance with the provisions of the agreement and makes studies and plans of the coordinated operation for the advice and information of the members. The agreement provides for interchange of energy, for storage of energy, and for payments and entitlements between upstream and downstream plants. It also provides for coordination of the use of transmission facilities and charges for energy transfers. The coordinated planning of maintenance outages is provided. The amount and extent of system participation in providing for forced outage reserve, energy reserve, and spinning reserve is established by the group. MRB signatories to the PNCA are as follows:

MRB Signatories

Bonneville Power Administration
The Montana Power Company
Pacific Power & Light Company

ROCKY MOUNTAIN POWER POOL (RMPP)

RMPP was formed primarily for the purpose of coordinating operations of member systems. The pool is informal in that there is no master contract to which all members are signatory. However, there are numerous two-party and some three-party contracts that enable various power transactions to take place between the members of the pool. The pool is operated under the overall direction of a Policy Committee, with day-to-day operations supervised by an Operating Committee. The Operating Committee is responsible for maintenance coordination, enforcement of operating guides, reliability of the bulk power system, and reviewing the status of load growth and new facility construction. The pool has been particularly effective in coordinating USBR hydroelectric generation and the thermal production of other pool members. The RMPP is composed of 12 systems, of which the following seven operate within the basin:

MRB Members

Black Hills Power & Light Company
The Montana Power Company
Nebraska Public Power District
Pacific Power & Light Company (Wyoming System)
Public Service Company of Colorado
Tri-State G&T Association, Inc.
USBR - Upper Colorado & Lower Missouri Region

NORTHWEST POWER POOL (NWPP)

The purpose of the Northwest Power Pool is to make the best use of available facilities. Each member system prepares and circulates a weekly report containing information regarding load-supply situation, water conditions, fuel supply, maintenance schedules, and other conditions that might affect Pool operations. The Operating Committee and Coordinating Group agrees on principles and procedures for maintaining frequency and interchange control, interchange scheduling and accounting, maintenance schedules, relay settings, communications systems, generating reserves, reactive resources, voltage compensation, and other items affecting pool operation.

An outgrowth of the operating program of the NWPP is load shedding by underfrequency relays, so that area loads are matched to area generation, and in case of a major disturbance, generation may be maintained and load restored in an orderly and timely manner.

NWPP membership is comprised of 25 systems, but only 3 provide basin service:

MRB Members

Bonneville Power Administration
Idaho Power Company
The Montana Power Company -
Pacific Power & Light Company

INTERCOMPANY POOL (INTERPOOL)

INTERPOOL is a seven-member operating group within the Northwest Power Pool. The requirements for participation include actual or contractual interconnections with other members of the group. The pool was established for the purposes of coordinating power and energy resources, reserves, transmission facilities, storage, and periodically conducting studies of this nature. Exchange of capacity and energy is permitted within the pool agreement. The pool includes the following three MRB systems:

MRB Members

Pacific Power & Light Company
Idaho Power Company
The Montana Power Company

PACIFIC NORTHWEST UTILITIES CONFERENCE COMMITTEE (PNUCC)

PNUCC is an informal organization comprised of representatives from 25 utilities in the Pacific Northwest. Activities of PNUCC are primarily concerned with (1) reviewing the plans and programs of the Federal agencies and providing support for needed power projects and transmission facilities where Federal appropriations are required, and (2) evaluation of loads and resources on an overall forecast basis.

The annual power loads and resources report prepared under the sponsorship of PNUCC is known as the "West Group Forecast". This report compiles the load forecasts of all the utilities included in the West Group of the Northwest Power Pool. These 10-year forecasts include a comparison for each year of estimated loads with existing and scheduled generating plants.

MRB membership in PNUCC consists of two systems:

MRB Members

The Montana Power Company
Pacific Power & Light Company

NEBRASKA MUNICIPAL POWER POOL

The Nebraska Municipal Pool was created in 1976 as a planning body. At the present time, it includes 24 member municipal systems. Current plans call for a study that could lead to the construction of a large electric generating plant or joint participation with others in facilities within Nebraska.

NORTH DAKOTA ASSOCIATION OF MUNICIPALS

The Association began formally in May 1976 as a nonprofit corporation designed to cope with supply problems beyond USBR contract amounts. One of the organization's first objectives was enactment of legislation in North Dakota that would lift the present prohibition of joint municipal ownership of electric facilities.

WESTERN IOWA MUNICIPAL ELECTRIC COOPERATIVE ASSOCIATION

As of the end of 1976, seven member systems had entered into formal agreement to purchase a 16-MW share of Northwest Iowa Power Cooperative's 100-MW interest in

the Neal #4 unit. This commitment also covers agreement for connecting transmission from the Neal #4 unit through the Northwest Iowa Power Cooperative system. Northwest Iowa Power Cooperative is also the supplier of USBR power to these municipal systems.